

Image Editing:
Nine Packages
Prove It's Not Just
For Macs Anymore

**BIG
HARD
DISKS:**



In the Age
Of Windows, Truly
Large Drives Are
No Longer a Luxury

**NETWORK
EDITION
MAGAZINE**

Network Edition:
Wellfleet's Hot New
Router, Caching
Servers, and More

AT&T
EO 440

7 inches
2.2 pounds

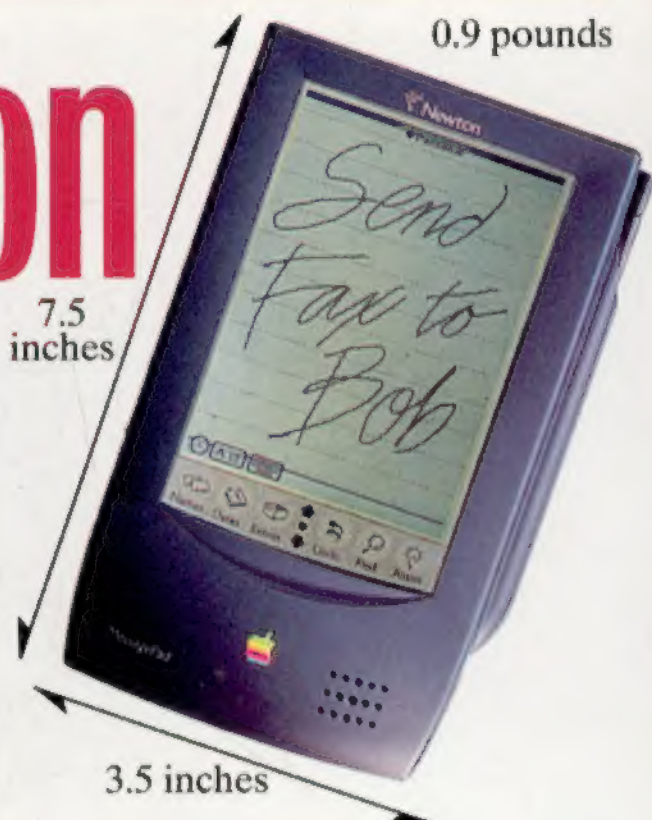


NETWORK
EDITION

10.8 inches

APPLE
Newton

7.5 inches



0.9 pounds

3.5 inches

**Pen
Pals**

CASIO

Z-7000

1 pound



6.8 inches

4.2 inches

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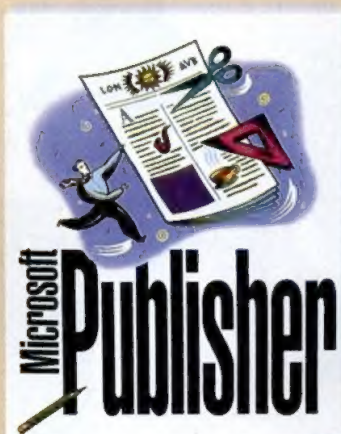
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ISLAND HOPPER NEWS

Free Newsletters For Passengers On Great Lakes Fun Vacays

Day Trips: Hurdle Botanical Gardens and Corell Island Farm

Winter, spring, autumn, or fall, there's always something to see at Hurdle Botanical Gardens.

Hurdle Botanical Gardens were founded in 1876 when Mrs. Agie Hurdle bequeathed her home and its surrounding 40-acre grounds to the town of Hurdle Harbor.

Mrs. Hurdle began her botanical garden with the goal of growing at least one plant from every nation on earth. Although neither Mrs. Hurdle nor the town has yet realized this goal, more than 125 nations are represented. Visitors from as far away as New Zealand and Pakistan have seen plants indigenous to their countries at Hurdle Botanical Gardens.

Entrance to the Hurdle Botanical Gardens is free, however a small donation is suggested. For more information, ask for a brochure at any Great Lakes Fun Vacays ticket booth.

There's Sunkin Treasure Along Ferry Route

The first scheduled crossings of Ginger Bay began in 1764 when French and English fur trappers arrived in the area and set up homesteads.

While renowned for their hunting and trading skills, the homesteaders had a few other perfect enduring records. In fact, during the 50-year "trading boom" from the late 1840s to early 1900s century, more than 80 boats - from 10-person rowers to 30-meter barges - are known to have succumbed to the high rocks and heavy winds.

(continued on page 3)

Summer Schedule (Subject to Change)			
Leave Corell Island 10:00 am	Leave Tappan Cove 10:30 am	Leave Hurdle Harbor 11:00 am	Arrive Warner Island 11:30 am
Leave Warner Island 12:00 pm	Leave Hurdle Harbor 12:30 pm	Leave Tappan Cove 1:00 pm	Arrive Corell Island 1:30 pm
Leave Corell Island 2:00 pm	Leave Tappan Cove 2:30 pm	Leave Hurdle Harbor 3:00 pm	Arrive Warner Island 3:30 pm
Leave Warner Island 4:00 pm	Leave Hurdle Harbor 4:30 pm	Leave Tappan Cove 5:00 pm	Arrive Corell Island 5:30 pm

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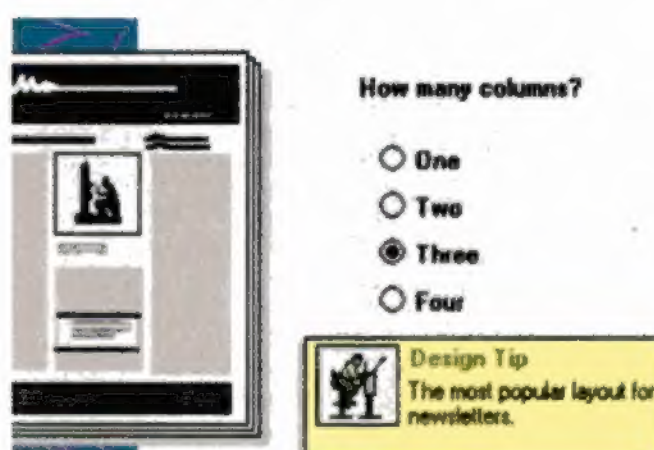


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Inside

SQL databases may be the biggest PC products we test, metaphorically speaking. They've been a mainstay of corporate databases, providing rock-solid data integrity and security. SQL vendors have responded to the downsizing trend by introducing PC-based versions of their products.

The task of testing these complex products in this issue fell to our applications development team, whose responsibilities include databases, operating systems, and computer languages. How complex is SQL? Associate editor Thomas Mace thinks the 16 weeks we took to test, write up, and edit our coverage of these products may be a new record for *PC Magazine*. PC Labs took on the look of a campground, as our Labs staff, vendors, and editors worked late into the night (and often through it) to get the products to work.

While SQL may give you an industrial-strength database, it also requires industrial-strength technical support. As they would if selling you such a product, vendors sent engineers to our Labs to set up the complex interaction of clients, servers, networks, and the gigabyte-size database we created. Ultimately, we were able to tell you which options are ready for prime time

and which still need work.

Our consultant, SQL expert Brian Butler, worked with the apps dev team to develop the tests that brought many of these products to their knees. PC Labs project leader Jay Munro—a former software developer—and technical analyst Dan Smith worked many hours to set up



The apps dev team (clockwise from upper left): Dan Smith, Jay Munro, Jamie Bsates, and Tom Mace.

equipment, make sure the tests worked, and analyze the results. Staff editor Jamie Bsates, a one-time English major, edited much of the copy. You can rate the result of their efforts in our article "PC-Based SQL: Time to Commit?"—Joel Dreyfuss

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"I'm no idiot. I can see that 3,000 visitors a day at \$10 a head adds up. I can only imagine how much they make from food sales and other stuff like those life-size posters of yours truly. All I ask is that they take good care of all the money that I'm working so hard for."

Name: Magilla

Title: The Boss / "The Ultimate Primate"

Company: The New City Zoo

Salary: All he can eat plus free health and dental

Annual Sales: \$11,000,000

5-Year Average Annual Growth: 75%

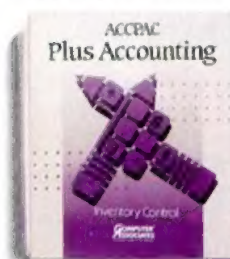
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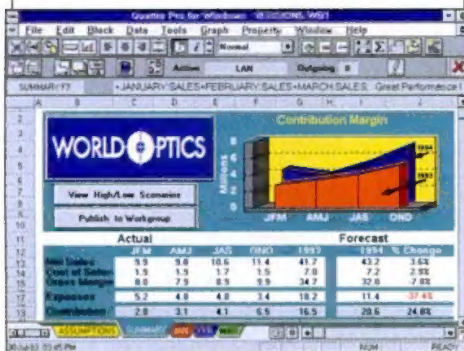
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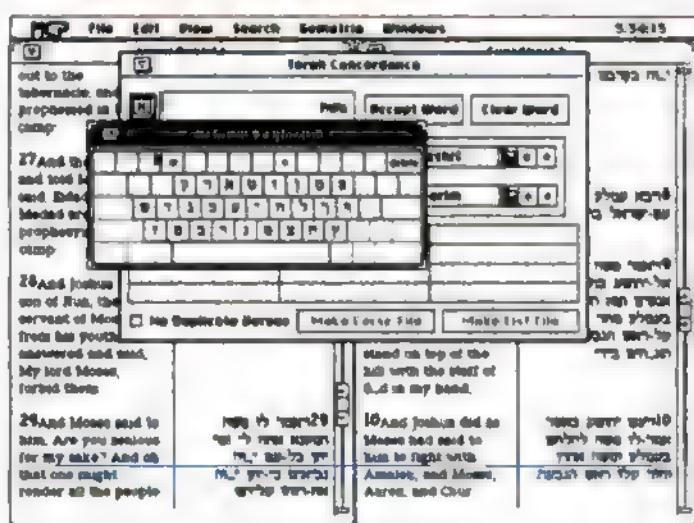
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The HP 4L isn't bad, but



THE HP 4L



*There's only one
option on the HP 4L.
A memory upgrade
from 1MB to 2MB.*

The HP 4L is a good laser printer. Just limited.

it's no ActionLaser 1500.



with RITech



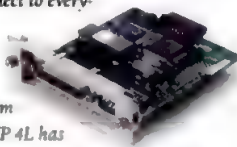
without RITech

Epson's RITech (Resolution Improvement Technology) increases the ActionLaser's normal 300 dpi print quality to eliminate jagged edges right where you need it: in the curved lines of letters, numbers and images. And Epson's MicroArt printing technology gives you deep, dark blacks and incredibly fine lines.



The ActionLaser 1500's top speed is six ppm. That's seriously fast, fifty percent faster than the HP 4L.

The ActionLaser 1500 comes standard with parallel and serial interfaces that allow two users to share a single printer. Add another interface and a third user can share the same printer. The ActionLaser 1500 can connect to everything from PCs to IBM mini and mainframe computers. The HP 4L has one interface.



PCL 5 emulation is standard. The extra power of Adobe PostScript is a simple plug-in option. With HP, you have to buy another printer to get PostScript.



27 fonts (13 scalable) are standard.

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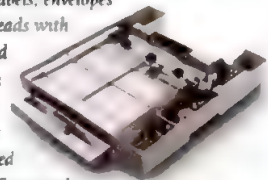


THE EPSON ACTIONLASER 1500



PC Computing Best Buy. (June 1993.) The word is getting around. The Epson ActionLaser 1500 is the best choice in personal lasers.

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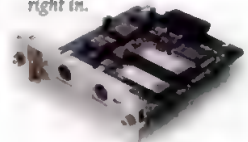


auto-feed cassette, for a total of 400 sheets. The HP 4L

holds 100 sheets. Envelopes, labels and overheads are manually fed, one at a time.

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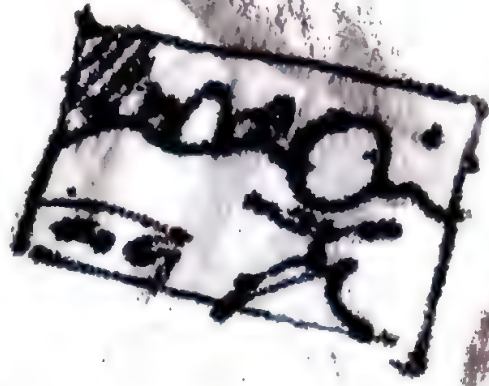
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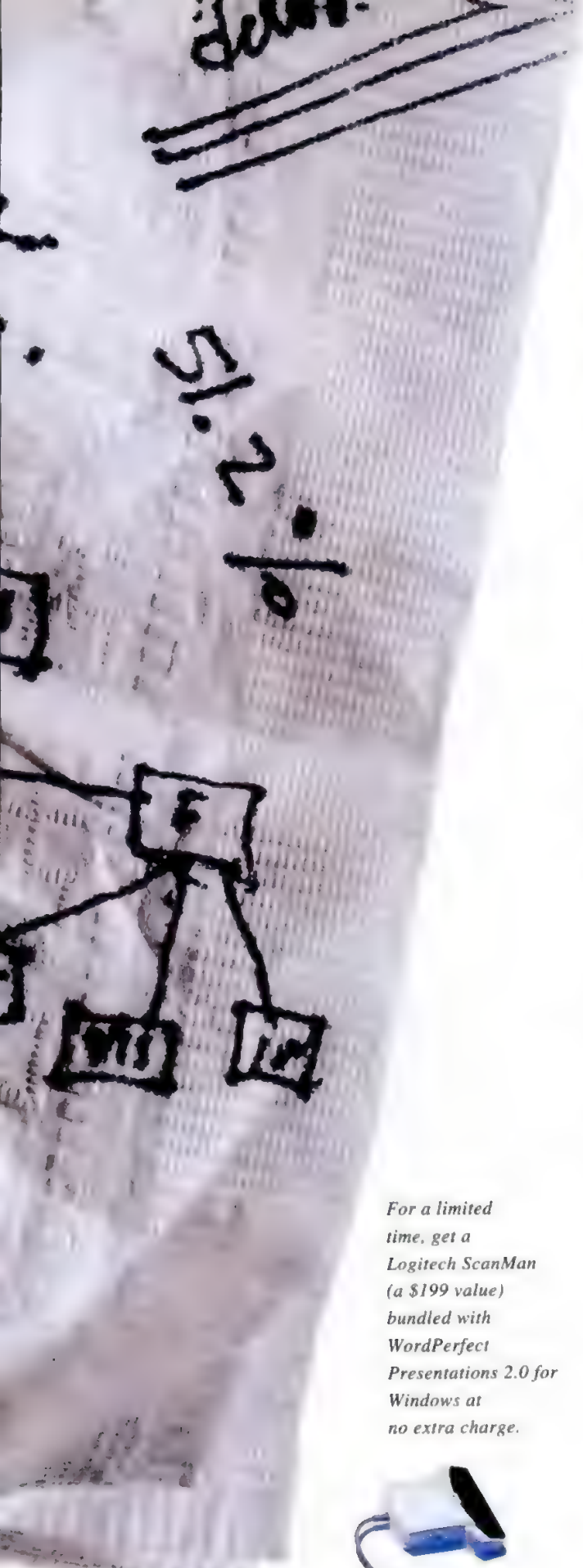
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Letters

CONTACT MANAGEMENT

Your review of contact managers in the August issue ("Contact Management: Keeping in Touch") was very enlightening, but being an avid SmartOffice user, I feel you did not give EZ-Data's product its just rewards. Our office finds SmartOffice best for the job because of the current and projected size of our database. SmartOffice also offers Remote Data Uplink (RDU) for mobile users, and a record screen that offers greater customization than the others do. I think *PC Magazine* is terrific. It's a tremendous help, and I anxiously await each issue, but sometimes when you review products it's difficult to grasp the depth of a product's functionality.

James Knight
Clearwater, Florida

After reading your August review of contact managers, I was surprised by your Editors' Choice award for ACT! for Windows. It is unquestionably the buggiest software I've ever purchased. The problems I've encountered have been acknowledged, and the company has provided workarounds on the appropriate CompuServe Forums. The program's concept is excellent, but until problems are corrected I wouldn't recommend it.

Jim Bates
Glendale, California

• **PC Magazine stands by its decision to award ACT! for Windows an Editors' Choice, based on its powerful features, performance, and ease of use.—Ed.**

I LOVE CORELDRAW, BUT...

As a CorelDRAW user for four years, I was pleased to see your First Look of Version 4.0 in the August 1993 issue. There's no argument it's an excellent application, but it has more than a few shortfalls. Among other things, you failed to point out that CorelDRAW's new Twain scanner support is limited to ISA-based scanners, and that SCSI scanners aren't supported. All carping aside, I've never found a competing product that I'd trade for CorelDRAW. But if Corel



*"Sometimes it's difficult
to grasp the depth of
a product's functionality."*

Corp. made its product truly full-featured, CorelDRAW would definitely leave the rest of the pack in the dust.

Jim Mathews
Glendale, California

CA-SIMPLY MISTAKES

I was surprised to read the favorable review of Kiplinger's CA-Simply Money in your August First Looks section. My experience is that this program has difficulties handling mutual-fund investments, and returns incorrect numbers on a range of financial reports. When a financial package errs in one important section, you have to reconsider its usefulness and wonder where else it may misrepresent financial results. Would the IRS accept a CA-Simply Money error as an excuse for a discrepancy on your income tax return?

Ron Rosenberg
Hoboken, New Jersey

BEATEN TO THE PUNCH

In your article "V.How Fast?" (Trends, August 1993), you announce breakthrough modem speeds of 19.2 kilobits per second that will soon come out as proprietary protocols from AT&T and Rockwell. Though it's not as well known,

the ZyXEL U-1496plus modem has been providing 19.2 Kbps as well as 16.8 Kbps, proprietary protocols, voice support, Class II fax, and Caller ID for a little over seven months.

James FitzGibbon
Scarborough, Ontario, Canada

A MASSIVE NEXTSTEP?

You must be applauded for your fine First Look of NeXTStep Release 3.1 for Intel Processors in your August issue. I'd like to add a qualification to your assertion that NeXTStep's "massive system requirements alone (16MB of RAM, 120MB hard disk space) put it beyond the reach of most users." I don't see NeXTStep's requirements as massive when compared with those of similar systems, like Microsoft Windows NT.

Henry McGilton
Portola Valley, California

A MOUSE YOU CAN LOVE

Amen to Jim Seymour for his high praise of Kensington Microware's Expert Mouse ("The Mouse's Tail, 1993") in your August issue! I liked Kensington's large trackball so much after using it at work, I bought one for my home. Once you've adjusted to a trackball, it's impossible to go back to a normal mouse. I'm glad to have found someone who agrees with me that a large trackball is the only way to go.

Jeremy C. Radwan
North Olmsted, Ohio

• **Check out the announcement of Kensington's newest Expert Mouse in this issue's New & Improved section.—Ed.**

HANDS OFF THE WINDOWS API

I was appalled to read John C. Dvorak's "Will Windows Turn Proprietary?" in your August issue. Mr. Dvorak makes the mistake of assuming that Windows belongs to the public. Well, it belongs to Microsoft, and how Microsoft chooses to develop and market its product is its business.

William A. Donabedian
Cincinnati, Ohio

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LETTERS

Windows is Microsoft's property. Microsoft has done the work, taken the risks, and justly received the rewards. If it is in Microsoft's interest to make the Windows API unusable by other companies, then Microsoft has every right to do so.

*Jonathan S. Cargan, M.D.
Iselin, New Jersey*

Mr. Dvorak's columns on Microsoft, plus the letters sent in by readers, share the same theme: How dare Microsoft play hardball to obtain an even greater market share! There's a more important point to be made about the consequences of dominating an important market: the potential of government regulation.

*Paul A. Coleman, Ph.D.
Saint Louis Park, Minnesota*

GOING MOBILE TODAY

On page 382 of your August feature, "Wireless Communications: Connecting over the Airwaves," you say that "mobile satellite communications are still some way away." Actually, mobile satellite communications, including packet switching, messaging, and location services, have been available worldwide through the Inmarsat satellite system for several years. If your readers would like information, they can contact Comsat Mobile Communications at 22300 Comsat Dr., Clarksburg, MD 20871.

*Peter Wood
Vienna, Virginia*

NO REFUNDS OR EXCHANGES

I had ordered Smartcom for Windows before reading about its problems with advanced setup in your July 1993 First Look, "Smartcom for Windows Installs Best on Hayes Modems." Also, it will only run at 9,600 bps on my 14,400-bps U.S. Robotics modem. Hayes told me it only supports Hayes modems and could only guarantee that the software would run on Hayes modems. I knew I had a problem when the invoice stated "No refunds or exchanges on Hayes software."

*Gil Seiler
Santa Rosa, California*

YOUR SECOND HARD DISK

Your July "Perfect PC" issue contained a wealth of information, but the section entitled "Installing Your Second Hard Disk" caused me endless frustration. I'd just purchased a second hard disk drive from a mail-order company. The drive arrived with no mounting hardware and no instructions, but I knew I had *PC Magazine*. Unfortunately, the new drive wouldn't work as a slave to the drive I already had installed. It turns out my cur-

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rent drive had five sets of jumpers rather than three, and the jumpers had to be configured for both a master and a slave drive. I tried again with the new settings, and both drives worked perfectly.

The moral of the story is, many drives may contain three sets of jumpers and be configured to work the way you described them, but not all drives are built that way. If you're going to install a second hard disk drive, you should have instructions for both drives in front of you. It'll save time and effort.

*Don Trapani
Sacramento, California*

DISCUSSING OS/2

Thanks in part to reviews in *PC Magazine*, I've just become a new owner and user of OS/2 2.1, and I'm delighted with it. OS/2 is without question one of the slickest pieces of software engineering to come down the pike. The purchase price of OS/2 is some of the best-spent money I've devoted to my PC. It's delightful to have a real multitasking operating system underfoot for a change.

*Russ Teasdale
San Luis Obispo, California*

I've been following the new trends in operating systems in the press, and I decided to give OS/2 2.1 a whirl. In short, I hate it. I hate OS/2 for the same reason I hate working on a Macintosh computer: the object-oriented desktop. Assigning icons and programs to objects is a long and complicated task. Just trying to do standard desktop maintenance and customization is a tedious task. I admit, I was warned. You need a different mindset to work with OS/2.

*Jim Millard
Kansas City, Missouri*

LEARNING WINDOWS

I just finished going to school for two and a half hours, every Wednesday night for eight weeks, to learn Windows 3.1 using Microsoft's introductory and intermediate courseware training guides. I can't believe it took that much time to learn an operating system interface that's supposed to make it easier to use my computer. We spent half the time learning things like how to customize colors and wallpaper, how to draw pictures on the world's most expensive Etch-A-Sketch, and how to use a calculator. At least we didn't take time to learn how to play games.

*Niels H. Nielson
Princeton, New Jersey*

CORRECTIONS AND AMPLIFICATIONS

In our July 1993 feature, "Software Support and Satisfaction: How Happy Are You . . . Really?," we incorrectly reported on page 316 that Lotus Development Corp. provided toll-free support for Ami Pro. Lotus provides free support over a toll line that continues beyond the first 90 days after purchase.

HOW TO WRITE TO PC MAGAZINE

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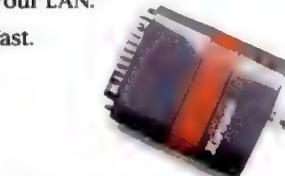
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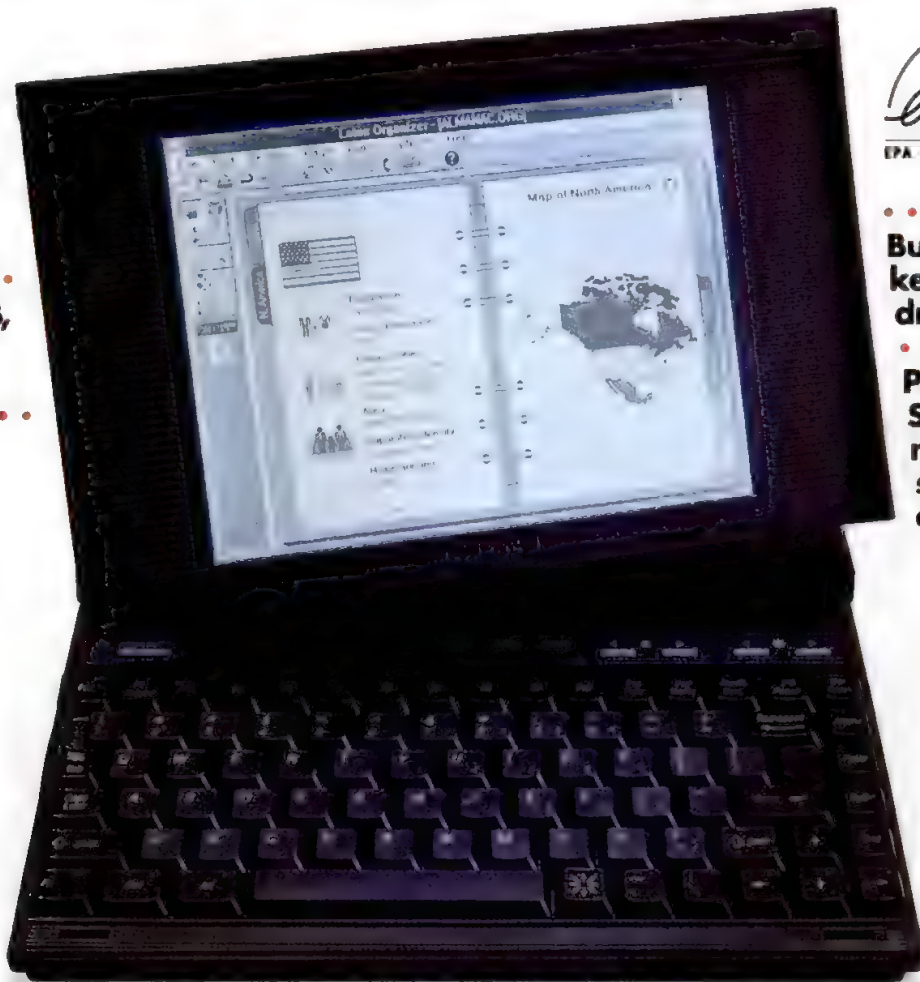
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PACKAGE 2

386SL Freestyle: \$1795

Lease: \$65/month

- 6MB RAM
- 120MB IDE hard drive
- Custom nylon carrying case
- MS-DOS 6.0
- Microsoft Windows 3.1

486SL Freestyle: \$1995

Lease: \$72/month

- 4MB RAM
- 120MB IDE hard drive
- Custom nylon carrying case
- MS-DOS 6.0
- Microsoft Windows 3.1

PACKAGE 3

386SL Freestyle: \$2295

Lease: \$83/month

- 10MB RAM
- 180MB IDE hard drive
- Internal 2400 bps V.42 bis modem with 9600 bps send/receive fax
- Custom nylon carrying case
- Extra battery
- External charging stand
- MS-DOS 6.0
- Microsoft Windows 3.1

486SL Freestyle: \$2495

Lease: \$90/month

- 8MB RAM
- 180MB IDE hard drive
- Internal 2400 bps V.42 bis modem with 9600 bps send/receive fax
- Custom nylon carrying case
- Extra battery
- External charging stand
- MS-DOS 6.0
- Microsoft Windows 3.1

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**486SL version
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**VGA backlit
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make next to
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—PC Week

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PACKAGE 1

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486SL Contenda: \$1795

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- 4MB RAM
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PACKAGE 2

386SL Contenda: \$1595

Lease: \$62/month

- 4MB RAM
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- External 3.5" floppy disk drive
- MS-DOS 6.0
- Microsoft Windows 3.1
- Lotus Organizer

486SL Contenda: \$1995

Lease: \$73/month

- 4MB RAM
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- External 3.5" floppy disk drive
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- Microsoft Windows 3.1
- Lotus Organizer

FAVORITE OPTIONS

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MEMORY UPGRADES

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- 486SL: 4MB to 8MB upgrade **\$198**

COMMUNICATION

- FastLynx File transfer software **\$79**
- Internal 2400 bps modem with 9600 bps send fax and 4800 bps receive fax **\$99**
- Xircom Ethernet adapter (10BT or Coax) **\$349**

PACKAGE 3

386SL Contenda: \$1795

Lease: \$69/month

- 4MB RAM
- 80MB IDE hard drive
- External 3.5" floppy disk drive
- Custom nylon carrying case
- Extra battery
- Internal 2400 bps modem with 9600 bps send fax and 4800 bps receive fax
- MS-DOS 6.0
- Microsoft Windows 3.1
- Lotus Organizer

486SL Contenda: \$2395

Lease: \$87/month

- 8MB RAM
- 80MB IDE hard drive
- External 3.5" floppy disk drive
- Custom nylon carrying case
- Extra battery
- Internal 2400 bps modem with 9600 bps send fax and 4800 bps receive fax
- MS-DOS 6.0
- Microsoft Windows 3.1
- Lotus Organizer

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- IDE hard drive.
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- 256K (386SL version) or 512K (486SL version) video RAM.
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CIRCLE 334 ON READER SERVICE CARD

Trends

TRENDS & TECHNOLOGY SHAPING THE PERSONAL COMPUTER MARKET

The Big Squeeze

DOS compression wars heat up.



What once seemed like black magic is now big business. Real-time disk compression, the art of squeezing files onto a disk in order to gain more storage space, figures prominently in the latest operating system wars. As Microsoft did with MS-DOS 6.0, Novell and

IBM are making disk compression an integral part of their variants of DOS.

But disk compression isn't simply a matter of wringing a few more megabytes out of a disk. Now Novell is looking to compression as a way to move files more quickly across the network, and Microsoft, burdened by the Pandora's box of complaints that DoubleSpace opened in MS-DOS 6.0, will offer version 6.2 to mollify wary customers. IBM, gun-shy from watching the others, encloses a coupon for SuperStor.

According to Microsoft, DoubleSpace is used by 62 percent of its 10 million owners. That surge of users made Microsoft the largest vendor of compression software, and illuminated shortcomings that made DoubleSpace potentially unsafe on some PCs.

Microsoft's update, expected later this fall, will have a number of new features, but adding a safety net to DoubleSpace is its primary reason for being. MS-DOS 6.2 will have a new utility, Scanfix, that examines a disk, repairs crosslinked files, and moves

data from bad blocks before the disk is compressed. DoubleGuard will checksum data before writing to disk. And you'll be able to automatically uninstall DoubleSpace.

Novell, which bought Digital Research and its DR DOS two years ago, intends to use compression to speed up NetWare's data highway. First it will ship Novell DOS 7.0 with Stac Electronics' Stacker disk compression software as part of the operating system, preloading the compression driver (as does DoubleSpace) to make it safe.

But Novell's inclusion of Stacker goes much deeper than DOS. Novell has licensed the Stacker LZS compression format with a grand goal of compressing NetWare networks. It chose Stacker because it's multiplatform: There are versions for DOS, Macintosh, and OS/2. Novell plays in those arenas and plans to incorporate Stacker LZS into its Unix clients as well as into the NetWare file system. With compression built into the operating systems and the multiplatform clients, compressed files could be

sent over the network without being decompressed first, which would increase network throughput.

In comparison to Microsoft and Novell, IBM's compression picture seems near-sighted. When it shipped PC-DOS 6.1, compression was left out. In the box, IBM included a coupon for Addstor's SuperStor disk compression software, which IBM intends to ship to users later this year.

As we went to press, legal skirmishes over compression patents continued, with Microsoft firing a lawsuit at Stac claiming that Stacker infringes on Microsoft patents.

—Christopher Barr

Clock Triplers

CLOCK-DOUBLED 486s LIKE INTEL'S DX2/66 are a great way to get outstanding performance on your PC. They've become so popular that AMD, Cyrix, and IBM have also gotten into the act with their own clock-doubled chips. Now IBM, beating even Intel out the door, is the first with a clock-tripled chip that IBM claims runs faster than any 486 available today.

IBM's Blue Lightning is a 486 that runs at 25 MHz externally, 75 MHz internally. Your applications won't run three times faster on a clock tripler, but PC Labs tests show that a clock-doubled Intel 486DX2/66 is about 80 percent faster than a 33-MHz 486DX. We won't know how fast the Blue Lightning runs applications until we test it.

There are a few caveats to consider before buying a Blue Lightning chip. If you're looking for Pentium performance, buy a Pentium instead. With its dual integer pipelines, 64-bit bus, and other fancy new features, even a 60-MHz Pentium will out-muscle a 33/99-MHz Blue Lightning chip. Also, you can't buy a Blue Lightning chip to upgrade your PC as you would an Intel OverDrive chip—the license from Intel only lets IBM sell them soldered to a motherboard, but a handful of companies are selling the motherboards.

You may want to wait until Intel ships its 100-MHz clock tripler. Code-named P24C, Intel's "DX3" is expected by the end of 1993.

—Christopher Barr

Pipeline By Robin Raskin

Seedy ROMs

There are those who say that what multimedia needs is a killer app—an app so compelling that you won't want to be without it. If we listen to the mass media, the multimedia killer app may be digital pornography. I've heard it called, aptly enough, Seedy ROM (which happens to be the title of a CD porn collection).

Over the last few months I've had calls from most of the major news broadcasters, all in a frenzy about the latest craze: software sex. One network began a recent broadcast claiming that "adult software was the fastest growing category of software." At InterMedia, a CD-ROM trade show, the adult software exhibitors drew considerable attention, despite the fact that there were only a handful of them.



Details magazine recently ran a feature about a guy trying to create a virtual embodiment of his ex-girlfriend on his Macintosh. *Esquire* ran a piece about cyborgasms—a high-tech sex experience.

Penthouse launched its own CD-ROM: You play the role of the *Penthouse* photographer. Rumor has it that Tina Brown is about to further legitimize the topic with a *New Yorker* thought-piece on computer porn. And Brady Publishing has recently published *The Joy of Cybersex*.

Of course, while we're airing dirty laundry, there's *PC Magazine*. Our own ads for adult software are mushrooming. Those impossible-to-find, black-and-white, fine-print ads in the

back of the magazine have been replaced with color head shots of winking women and bold prose. Love it or hate it, there's something happening here. It's happening on many levels, it's happening quickly, and it should not be ignored. As we go to press, *PC Magazine* is in the process of redefining its policies toward sex-software advertisers. Stricter guidelines for content, graphics, and even placement will be enforced.

It would be incredibly pompous of us to believe that the computer industry can escape dealing with the pornography issue. There has never been a medium—books, film, video, painting, music—where pornography dared not tread.

Digital video and sound, photorealistic color, high-speed modems, and CD-ROMs have all helped create this new industry. Technically speaking, there's plenty of room for improvement. Most graphics are grainy and pixelated—no match for videotape. The interactivity is minimal. Some of the text is downright moronic. And the stuff is expensive, whether you find it on an adult bulletin board, a CD-ROM, or a disk.

Still, we know that there are buyers. The response rate to the ads is substantial. And we know, whether we like it or not, that it will continue to grow in all sorts of creative ways, including forays into the virtual-sex frontier.

I have no answers and many mixed emotions about where we are heading. But I have this very definite, wistful/nostalgic coming-of-age feeling that won't go away. When computers were simply a tool, no one but a few gadget freaks cared. Now they are more than a tool; they are a medium. And as a medium they will be thrashed about and sensationalized in the press just like any other medium. So get ready.

Robin Raskin is an executive editor of PC Magazine.

Quick Thinking Neural Networks

BY SIMULATING THE LEARNING process of the brain, Intel's neural network chip is expected to give the PC new thinking abilities. One application of the chip is in imaging technology, where the chip's high speed and intelligence could give a big boost to handwriting recognition. Nestor, an OCR developer with a \$400,000 stake in the NI1000 Recognition Accelerator, sees the chip as fueling the transition to electronic imaging.

Packed with 3.7 million transistors, 1,024 silicon "neurons," and a remarkable memory, the chip performs 20 billion operations per second, say the chip's designers, and replicates the brain's synapse/neuron communication system. If it works as Intel says, it will recognize objects, shapes, and sounds, and will handle CPU brain teasers such as pattern and speech recognition. "You won't see this chip in every PC in the office, but it does add value to the PC environment," says

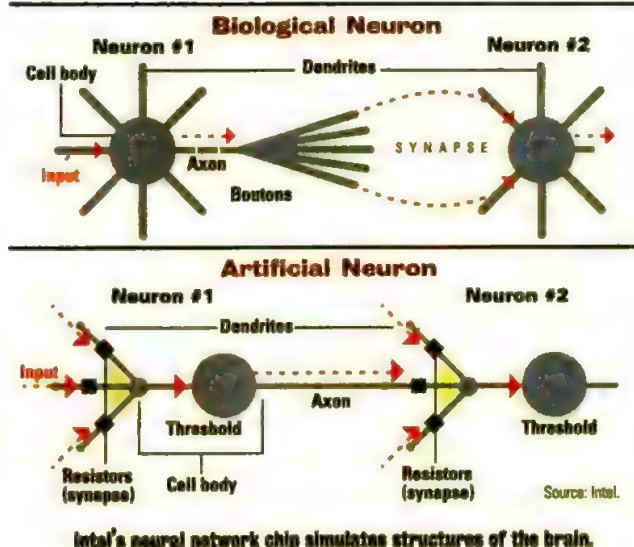
Mark Holler, director of neural network chip development at Intel.

For companies that rely on document imaging on a grand scale, neural network technology is a big step forward. *Intelligent character recognition* software (OCR that converts handwritten forms into editable

ASCII text) accelerated by the chip will recognize 40,000 characters per second compared to today's rate of 10 to 100 cps, according to Nestor, and is expected to perform finer feature extraction.

Will the chip herald the age of the paperless office? "The transition from paper to image will be slow," says Mike Glier, vice president of embedded technology at Nestor. OCR vendors do not have immediate plans to support the chip, but are waiting instead until it becomes as general purpose as the floating-point processor is today. Critics point out that it may be premature to freeze today's technology in silicon when recognition software is improving every year. The first entry-level ISA card products are expected by 1994.

—Carol Levin



Repackaging News

NEWS BUFFS WONDERING WHEN the multimedia revolution will deliver on its promises can get a taste of the future today. Major news publishers, on-line services, wireless carriers, and personal digital assistant (PDA) makers are pooling their expertise to repackaging the news.

Already, 140 newspapers and periodicals are posted on the on-line services, and new editorial products are taking shape on CD-ROMs, on-line forums, and wireless services. Newsweek Interactive and Multimedia Businessweek 1000 are new CD-ROMs that offer greater depth than their paper counterparts. America Online (AOL) and The Tribune Co. run Chicago On-line, where subscribers can access the full text of *The Chicago Tribune* and chat with readers. AOL has also teamed up with Knight-Ridder and the *San Jose Mercury News* to run extra news stories and a bulletin board. In September, AOL and Time open Time Online, a forum where readers can chat with writers. And to provide highly localized news folks can't get from the paper, both Times Mirror (*The Los Angeles Times*) and Cox Enterprises (*The Atlanta Journal and Constitution*) have teamed with Prodigy.

To help you cope with the resulting information overload, information refineries have sprouted up. Individual Inc. (617-354-2230) transmits a personalized package of news called HeadsUp over Motorola's EM-BARC wireless e-mail system. Subscribers get early morning briefings on news relevant to their businesses culled from over 200 sources. Mainstream Data (801-584-2800) sends dozens of news feeds over FM radio and satellite to PCs equipped with a receiver box. With its Newscast for Windows software, you can filter the news by keyword. A receiver for PDAs is expected by 1994, and later, a PCMCIA card implementation.

Eager to stimulate the fledgling PDA market, news providers and PDA makers are also building friendships. Individual now transmits to AT&T's EO, and Apple Online will transmit to Apple's Newton, which contains Motorola's MessageCard—a receive-only wireless modem on a PCMCIA card.

And the year-old News Electronic Data, a division of Rupert Murdoch's giant News-Corp., is working with PDA makers as well.

Meanwhile, developers are experimenting with software that presents information in a newspaper layout. WalkSoft's News in Motion, a weekly compilation from foreign papers (716-271-8250), and PED Software's

Journalist (see First Looks) are now available. And at Knight-Ridder's Information Design Lab in Boulder, CO, Roger Fidler is designing a futuristic tablet newspaper. "Before electronic newspapers are accepted," he says, "they'll have to be cheap, completely intuitive,

something you can read in bed." With any luck, that'll happen by the end of this decade.

—Carol Levin



Electronic newspapers deliver extra coverage.

Epson's Tiny PC On a Card

THE EXPLOSION OF INTEREST IN miniature computing was spawned largely by the growth of PCMCIA cards and PDA microprocessors like the Hobbit, the ARM, and the Dragon. Now, Epson America and S-MOS Systems, both affiliates of Seiko-Epson Corp., have introduced a step forward in portable computing with the Cardio-386, a full-fledged Intel 80386SL-based motherboard in a sealed package that's 3.5 inches wide and 2.25 inches deep.

What looks like an oversized credit card is actually a tiny computer encased in a tough metal shell that runs off a proprietary 236-pin edge interface. It has most everything necessary to run a PC: 1MB or 4MB of RAM; 128K or 256K of ROM; keyboard, VGA, and floppy disk controllers; and a 3.3- or 5-volt power supply. Only an internal IDE controller is missing; Epson says this can run off an external ISA bus.

The Cardio is initially targeted as an embedded device for the industrial market, but both companies predict that it will slide into the consumer market for desktops, palmtops, PDAs, VCRs, and fax machines. "Cardio is one of the best solutions for laptops and PDAs," says Joel Silverman, director of strategic marketing at S-MOS

Systems. Also, the Cardio would enable manufacturers to build CPU cases that are much smaller than today's and would let PC users easily upgrade their machines.

Evaluation products are available for \$790 and will drop to \$374.50 in quantities of 1,000 upon full production. In September, OEM manufacturers can order Cardio evaluation kits—a \$910 version including an external interface board, and a \$2,310 kit with all the basic peripherals (LCD panel, hard and floppy disk drives, and power supply).

Epson is not limiting this technology to the Intel 386. Intel 486 chips and higher are in the works as well as a Power PC version. As of August no manufacturer has announced a competing product. However, AMD is expected to enter this market soon.

—Oliver Rist

Top Retail Software

Current ranking	Last issue	Product/company
1	3	Access for Windows 1.1 Upgrade Kit Microsoft Corp.
2	1	Microsoft Windows 3.1 Microsoft Corp.
3	11	Money for Windows 2.0 Microsoft Corp.
4	—	DoubleTools for DoubleSpace 1.0 Addstar Inc.
5	10	MS-DOS 6.0 Upgrade Kit Microsoft Corp.
6	—	Publisher for Windows 2.0 Microsoft Corp.
7	5	WordPerfect 6.0 for DOS Upgrade Kit WordPerfect Corp.
8	2	QEMM 7.0 Quarterdeck Office Systems
9	6	Quicken 2.0 for Windows Intuit
10	8	WinFax Pro 3.0 Delrina Technology
11	—	Procomm Plus for Windows 1.02 Datastorm Technologies
12	—	Office for Windows 3.0 Microsoft Corp.
13	—	Saber LAN Workstation 1.00 Saber Software Corp.
14	7	WordPerfect 5.2 for Windows WordPerfect Corp.
15	12	Procomm Plus 2.01 Datastorm Technologies

The list ranks PC business programs according to the total number of copies shipped to stores and resellers in the week ending August 7, 1993. The list is based on shipments to more than 12,000 retail locations. It does not include sales made directly by software publishers and can not be interpreted as a picture of the entire software market. Sales information compiled by Ingram Micro.

Briefs

IS THERE A COMPUTER IN YOUR HOME?

If so, then it's probably a 386 or 486 that you use 20 hours a week to run your home business, 5 hours a week for work you bring home, and 4 hours for entertainment, reports the Software Publishers Association. You base buying decisions on advice from friends and on price, and there's a 50 percent chance your income is over \$50,000.

GIVE A KID A PC AND GET A TAX BREAK.

The Computer Recycling Center will service your donated PC and send it back to work in a public school. CRC also places PCs in the homes of disadvantaged students and teams up technical volunteers with teachers. 408-734-5030.

STORE-ON-A-DISK, A PILOT SOFTWARE

distribution program from Gateway 2000, is a CD-ROM disk filled with

Microsoft applications. Browse through, then call an 800 number and exchange your credit card number for a code that unlocks and installs the application.

JUST HOLD THIS UNDER YOUR TONGUE.

PCbid Computer Technology now sells the Pentium CPU Kooler (916-338-1338), a heat sink and mini-fan that cools the processor and has a probe port for a digital thermometer so you can monitor the temperature. The company says overheating can hang the 16-watt Pentiums and corrupt data.

ANOTHER FREEBIE SOFTWARE PROMO-

tion, this time for Do-It-Yourself Accounting from Central Computer Products. The first 100,000 callers get the \$69.95 Windows accounting program for \$6.95 shipping and handling. 800-373-3946.

should be about the same size as Sony's audio MiniDisc player, which is about 5 by 7 inches and weighs 1.5 pounds. Since the first licensees to use the technology won't be announced until the end of 1993, Sony is unwilling to estimate prices but suggests its cost will be on a par with the audio MiniDisc recorder/players priced from \$750 to \$1,000.

Although today's 5.25-inch MO drives store from 650MB to 1.3GB, the 2.5-inch MD Data disks hold 140MB, which is a bit more than the 128MB of today's 3.5-inch MO standard. But Sony thinks the MD Data format will be used for personal backup and storage on notebooks and PDAs, while the larger, more expensive drives will be used

for corporate archives.

While Sony was not clear as to how to connect the drive to a SCSI cable attached to the PDA's PCMCIA socket would be the best method. And since Sony's MD Data drives will play (but not record) disks recorded in Sony's MiniDisc audio format, you can listen to music as you use your PDA.

—Christopher Barr

Clean Machines

NEW TECHNOLOGY IS HELPING RE-engineer the computer to be an environmentally sound citizen, but there's another side to the computer industry's environment-friendly efforts. There's an effort underway to clean up the PC manufacturing process, with companies taking measures to eliminate hazardous materials from component manufacturing and packaging.

The Clean Air Act calls for companies to eliminate substances harmful to the earth's protective ozone layer by 1996. This includes *chlorofluorocarbons* (CFCs; used as a cleanser in the production of circuit boards) and methyl chloroform (used as a metal cleaning solvent for parts other than circuit boards and in the photo-lithography process). "PC manufacturers have done an admirable job, aggressively getting out earlier than they have to," says Sue Stendebach of the EPA.

Alternative production methods are key to the computer industry's successful retreat from ozone depleting materials. There are now three popular options for avoiding the use of CFCs—aqueous, semi-aqueous, and no clean flux process (NCF). The latter, which is embraced by a number of companies, has the additional benefit of cutting lead waste. Compaq is the latest company to join Hewlett-Packard, Apple, and others who have eliminated CFCs.

In August, IBM went one step further by establishing the Environmental Health and Safety Technology Services group. Drawing upon IBM's expertise, the unit helps businesses circumnavigate the complexities of environment-related decisions and comply with governmental regulations.

Often the costs of instituting green policies are offset by the benefits. Besides complying with governmental regulations and providing positive public relations, the elimination of environmentally unfriendly practices usually means savings.

But challenges lie ahead, especially for companies with multinational operations. Evolving legislation results in confusing and sometimes conflicting standards, keeping manufacturers on their toes. Several companies are working in cooperation with suppliers to reuse component packaging, while recyclable, CFC-free packaging is growing in popularity. Meanwhile, nontraditional recycling programs are addressing the mounting waste from laptop batteries, toner cartridges, and floppy disks.

—Melissa J. Perenson

PDA Data Storage

AS AUDIO GOES, SO GOES THE PC. Last year Sony released the MiniDisc, a 2.5-inch platter to supplant the audio CD standard it invented with Philips. Unlike ordinary CDs, the MiniDisc can be used for both recording and playback in a device about the size of Sony's original Walkman audio cassette player. This year Sony is promoting the MiniDisc format for computer data storage. Sony claims the 2.5-inch MD Data disc holds 140MB of data.

Based on magneto-optical (MO) storage technology, MD Data discs will come in three formats: prerecorded (like today's CD-ROM disks), recordable, and a hybrid disk that is part prerecorded and part rewritable. Sony claims blank disks should cost around \$20 each. MD Data disks require a new file format but the drives will be accessible under most common operating systems with the addition of a device driver.

The MD Data drive itself



Pixels per second

1,600,000

1,400,000

1,200,000

1,000,000

800,000

600,000

400,000

200,000

0

Close-Up 5.0

pcAnywhere
for Windows 1.0

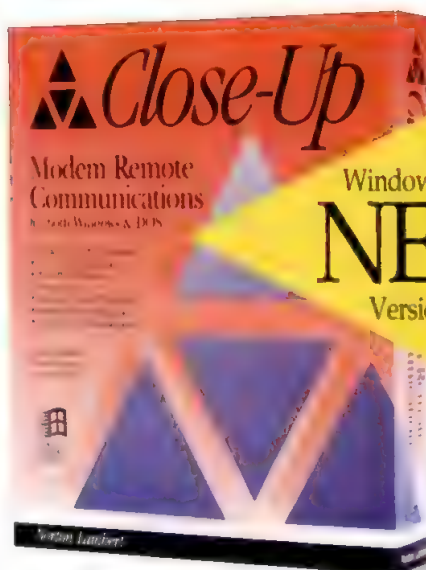
CarbonCopy
for Windows 2.0

WinBench scores
(average of 10 runs):
Close-Up 1,613,118
pcAnywhere 194,093
CarbonCopy 168,397

WinBench™ 3.11 by Ziff-Davis Labs Tests Remote Windows™ Speed

This graph shows the speed of the three leading remote control programs when transferring Windows screens. As you can see, Close-Up handles more pixels, faster, meaning you spend less time waiting for Windows screens.

The industry standard test, WinBench 3.11, is perfect for testing the speed of remotes. It is an accurate measure of video throughput. Video throughput is the limiting factor in remote operations, because remote programs must transmit Windows video functions from one PC to the other.



New Remote Software Sets Windows Speed Record

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1. AI Video Compression
2. Photographic Memory
3. Non-Intrusive Technology
4. Expert System
5. Video Translation

Benchmark tests (see WinBench 3.11 chart).

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Upgrade your current or competitive remote program to new Close-Up 5.0. Get both sides, Host & Remote, for only \$69.⁹⁵

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We invite you to reproduce this test. We used two identical Gateway 4DX2-66V's with 66-MHz Intel 486DX2-66 CPUs, 16 MB RAM, 256KB RAM cache, 40 MB HD, IDE controller, no hardware disk cache. Video: Local Bus ATI Ultra Pro with 2MB VRAM, 640 by 480 pixels, 16 colors, VGA.DRV dated 3/10/92. Monitor 72 Hz. MS-DOS 5.0, SMARTDRV 2 MB cache. Modems: two 14,400 baud V.32bis. WinBench 3.11 is available on ZiffNet accessible via CompuServe. Test performed without verification by Ziff. All products are shipping versions. WinBench trademark of Ziff Communications Co. Windows trademark of Microsoft Corp.

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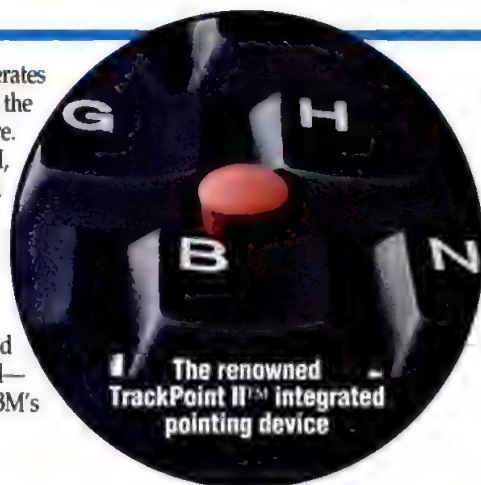
PC Magazine, Cover Story Portable PCs, August, 1993

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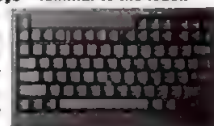
PCMCIA capabilities give you options for future expansion and technology. Additional memory, adapters, and hard drives are easy to install.

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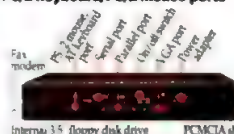
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Size/Weight

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- Monochrome 5.2 lbs with battery
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Pointing Device

- TrackPoint II

Battery

- Monochrome up to 5 hours with power management

- Color up to 3 hours with power management
- NiMH (no memory effect)
- 2.2 Amp/Hours
- Universal AC Adapter
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- Automatic and manual suspend/resume button
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- Microsoft Windows 3.1
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- PS/1 Edition
- PS/1 Tutorial
- PS/1 Index
- PS/1 Fitness
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Display

- 1024 x 768 for external monitor with 512K x 640 RAM
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- Adjustable contrast and brightness

Keyboard

- Full-function keyboard with 85 keys and 4 function keys

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I/O Ports

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- PCMCIA 2.0 slot

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The WinBook by Micro Electronics™ gives you the power to run Windows and a unique, ergonomic design to make it easier to use.

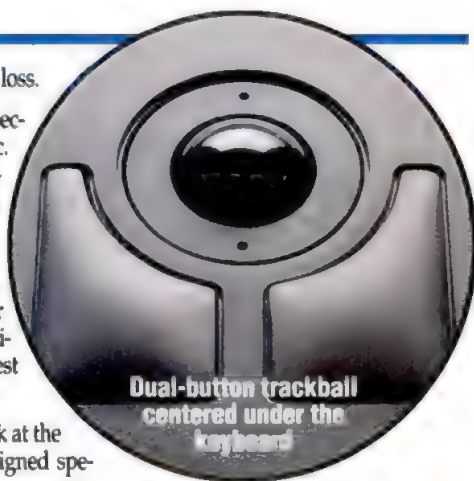
It features a built-in, centered trackball which allows you to control cursor movements effortlessly without having to lift a single finger off the keyboard. Full-size keys and a sloping hand rest let you work in total comfort.

The WinBook comes with the power and speed needed to run Windows effectively. You get 4MB memory, the ultrafast 486SLC/E processor and the Motorola chipset which provides eight power-saving features. Plus, we have fine-tuned the WinBook's screen. In monochrome and in dual-scan STN color—you get

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The WinBook was engineered for Micro Electronics, a division of MEI/Micro Center, Inc. MEI is America's leading direct source for computer products. Micro Center has been selling PCs for more than 14 years—longer than IBM or Compaq—with over 736,000 units sold. With over 2.2 million satisfied customers nationwide, we have developed a superior support staff including top engineers and technical specialists. So you always get the highest quality product at the lowest possible price.

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Dual-button trackball centered under the keyboard

WinBook™



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Specifications

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 - 5.9 lbs. with battery (dual-scan color)
- Printing Device**
- 16mm Alps dual-lithium; Microsoft compatible trackball

Battery

- Up to 3 hours with power management views 30 minutes longer
 - NiMH (no memory effect)
 - 2200 MA with gold-plated contacts
 - Worldwide auto-sensing AC adapter
 - Quick 2-hour recharge
- Power Management**
- Eight power-saving features

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 - Motorola chipset
 - 1K internal cache
- Drives**
- One built-in 1.44MB 3.5" floppy drive
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- Display**
- Super-herald 64 gray-scale 10" LCD and 1024 x 768 pixel external monitor with 512k video RAM
 - Optional dual-scan STN color display
 - Adjustable contrast and

brightness

- Visible LED indicator on cover-down
- Keyboard**
- Full-function keyboard with 85 keys and 4 inverted-T cursor control keys, 30mm keyboard spacing
- Modem**
- Fax 9600 baud send/receive; 14400 baud receive; 4800 baud internal

I/O Ports

- PS/2 mouse interface/AT keyboard interface
 - PCMCIA 2.0 slot
 - Serial 9-pin connector
 - Parallel port
 - Video 15-pin connector for CRT
 - 160-pin docking station
- Options**
- Coprocessor
 - Docking station

WinBook Features



Ergonomically engineered

The WinBook's ergonomic features include a sloping hand rest and keyboard, plus a centered dual-button trackball—allowing you to work in total comfort away from your desk.

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First Looks

HANDS-ON EVALUATIONS OF THE NEWEST SHIPPING PRODUCTS

■ Spreadsheet Competition Stays Hot

Quattro Pro 5.0 Excels at Modeling

BY CRAIG STINSON

The spreadsheet war rages on, and Borland International's latest assault is Quattro Pro 5.0 for Windows. Among other things, this much-enhanced version has more usability features, many valuable new analytic tools, a great "Data Modeling Desktop" that lets you create transposable cross-tabulations with a few simple mouse clicks, and the first manifestation of Borland's new workgroup strategy, nicknamed "obex" (for object exchange).

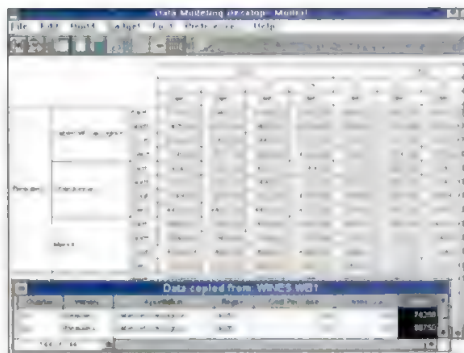
Borland has adopted a two-tiered pricing strategy for this version. For \$495, you get the works. For \$99.95, you get everything except the new spell-checker, the

workgroup features, SQL connectivity, and some new tools that simplify the installation of Quattro Pro on a network. For "unnetworked" users who are sure of their spelling, the scaled-down version of QPW 5.0 is an unparalleled bargain (especially at a special introductory price of \$49.95). And the high-end product (officially called the Workgroup Edition) is now a match for any other spreadsheet on the market.

THE SAME, BUT DIFFERENT

As before, QPW offers a notebook-metaphor approach to three-dimensional modeling. Page tabs adorn the bottom of the document window, and these may be named, grouped, and rearranged by simple, direct manipulation. The right mouse button still brings up the "object inspector"—a one-stop dialog box for setting formats and other attributes—but now you can also use the right mouse button as a shortcut for issuing commands as well as for setting properties.

Though the basic user interface remains unchanged, there are improvements everywhere. Drag-and-drop now works with single cells as well as with blocks. An unpaired opening parenthesis on the formula bar will automatically appear in red, and will turn to green only when you supply its closing partner. A click on the formula-bar function icon brings up a categorized list of QPW 5.0's functions, from which point a second click sum-



DATA SORT: QPW's Data Modeling Desktop.

names not just to the single cells immediately adjacent, but also to the entire rows and columns they head. QPW 5.0 will even offer to create names, such as January—Sales, based on the intersection of row and column headings; such names can dra-

mons relevant help text.

Labels can now center across columns. And row and column headings can now be assigned as

matically improve the readability of the formulas you create.

The graph button now looks

Continues on page 38

■ The Latest In Illustration

Micrografx's Designer 4.0 Stretches and Succeeds

BY JAMES KARNEY

It's been two years since the last version of Designer came out, and Micrografx hasn't wasted the time. Built on a new 32-bit graphics engine, Designer 4.0 has a slick new interface, 3-D drawing, state-of-the-art color-handling capabilities, and the ability to control output resolutions of up to 25,400 dots per inch (dpi). These and other features make the \$695 Designer 4.0 (\$149 to upgrade) a contender in the high-end graphics arena once again.

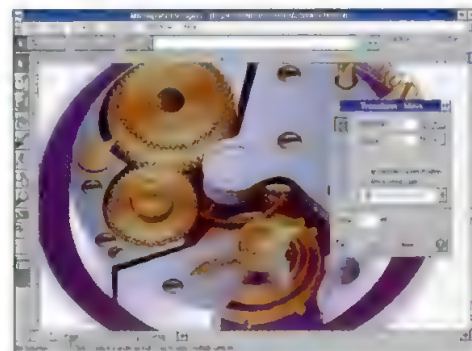
In addition to the basic program, the box also contains the bit-map editor Photo-Magic and Smart-Sep, a color-separation utility. Designer has

always been a favorite of technical illustrators, and they will find much in the new version to like. Other digital artists will find all the drawing tools they need to produce professional results.

MORE THAN A PRETTY FACE

Much of what Micrografx learned in designing Windows DRAW is evident in the improvements to the way Designer looks. The old interface is gone,

Continues on page 39



FACELIFT: Designer's new, improved look.

IN FIRST LOOKS

<i>WordPerfect Presentations 2.0 for Windows</i>	40
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Quattro Pro 5.0

CONTINUED FROM PAGE 37

at your selection and makes a reasonable guess about the chart type you want, giving you, for example, a pie if you've selected a single row or column with only a few data points. If you've assigned a standard date format to the first row or column, the graph button smartly assumes the dates should be x-axis labels, not plotted data. (Unfortunately, the program is not smart if your dates have user-defined formats.)

LOFTY ASSISTANCE

Holding down Ctrl while right-clicking on almost any of QPW 5.0's objects gets you a one-paragraph help balloon for that object. The balloon is linked to the help file, so detailed assistance is available. If you don't need it, your next click or keystroke releases the balloon. This "object help" will be really valuable for new users. Unfortunately, no such help is available for most of the objects in the

graph-editing window.

Other learning aids in QPW 5.0 include a set of interactive tutors and five "experts." What's innovative is that the interactive tutors give you the option of using your own data. (The program backs your data up first and gives you the chance to restore it after you run the tutorial.) The experts provide step-by-step hand-holding for building graphs and for using four of the program's more advanced new features: a scenario manager, a tool for consolidating data blocks, a formula compiler, and a whole suite

of statistical, engineering, and other analytical commands.

The Scenario Manager has a transparently simple user interface and makes effective use of color to highlight cells that

have changed and cells affected by changing cells. The Consolidator rolls up ranges based either on row and column labels, whether the ranges are identically organized or not.

CALCULATING

The formula compiler, which requires a math coprocessor, can provide modest performance improvements for worksheets containing many formulas. The expert evaluates your worksheet and tells you whether it would be worthwhile to incur the compiler's initial overhead. The analytic command suite covers essentially the same territory as Excel's Analysis Toolpak but also includes handy tools for building amortization schedules and analyzing

refinancing options. Topping off the new analytic features, Borland has roughly tripled the size of QPW's function library.

The Database Desktop now offers SQL connectivity (with drivers for InterBase, Sybase, and Oracle) but is otherwise unchanged. Regrettably, apart from the addition of an Excel-like Form command, QPW 5.0's internal database functionality—the procedures for querying tables built on the worksheet grid—are also unchanged.

Two new "desktops," however, are among the product's most impressive innovations. Like Excel's Crosstab Wizard, the

Data Modeling Desktop lets you transform inscrutable lists into tables that summarize information meaningfully. But, like Lotus Improv worksheets, the DMD's output can also be rearranged with simple drag-and-drop procedures. Items along either the row or column axis can be grouped, with details showing or hidden, and the entire table can be sent back to the worksheet as either static or linked data.

The Workgroup Desktop provides a Macintosh-like publish-and-subscribe system for sharing notebook pages or entire notebooks. Published documents can be transported by any of five

methods—MHS, MAPI, cc:Mail, MCI Mail, and LAN, and you can publish a document with any "version depth" you choose. Publishing with a version depth of 2, for example, would enable subscribers at all times to see the most recent state of a document along with its immediate predecessor. As an additional aid to document sharing, QPW 5.0 now supports OLE in both server and client modes.

In order to comply with a recent court ruling on look and feel, Borland removed its Lotus 1-2-3 keystroke reader from both QPW 5.0 and Quattro Pro for DOS. Keystroke sequences in imported 1-2-3 macros will now have to be modified to run correctly in the Borland spreadsheets. For many, if not all, prospective users, the point may well be moot. QPW 5.0 has more than enough attractions, with or without full 1-2-3 macro compatibility. □

■ Quattro 5.0 for DOS

The latest version of Borland's DOS spreadsheet is a true three-dimensional modeler, just like its Windows sibling. Quattro Pro 5.0 looks faintly like Quattro Pro for Windows, with nameable page tabs arrayed across the bottom of the worksheet grid. Formulas, range names, and graph series can spear through worksheets, and the handy SpeedSum button can tally up three-dimensional ranges as easily as two-dimensional ones. Pages can be moved with a drag of the mouse, and a Group command makes it easy to replicate a model's structure across multiple pages.

The screenshot shows the Quattro Pro 5.0 for DOS interface. At the top, there's a menu bar with options like File, Edit, Format, Data, Tools, Windows, and Help. Below the menu is a toolbar with icons for various functions. The main area displays a worksheet titled 'MouseTrap Sales Forecast'. The worksheet has columns for 'Q1', 'Q2', 'Q3', 'Q4', and 'Total'. The rows include 'Expenses', 'Revenue', 'Profit', and 'Margin'. The data is organized into a table with multiple rows and columns, showing sales figures and calculations. At the bottom, there are page tabs labeled 'Page 1', 'Page 2', and 'Page 3'.

PAGE TABS: Just like the Windows version.

But that's where the similarity between the Windows and DOS products ends, and that's all there is to tell about Quattro Pro 5.0. Borland is clearly and reasonably focusing all its research and development resources on Quattro Pro for Windows and will wait to see if the DOS market demands a higher level of spreadsheet functionality. Quattro Pro is still a great DOS spreadsheet, but it's only a tad greater now than it was in Version 4.0.—CS



From September 27 through October 1, you can go on-line to download a demo of Quattro Pro 5.0 or to discuss the program with Craig Stinson and Quattro product manager Song Huang. Type GO ZNT-EXEC from any CompuServe prompt.

► FACT FILE

Quattro Pro 5.0 for Windows

Borland International Inc.,
1800 Green Hills Rd., Scotts
Valley, CA 95067; 800-331-
0877, 408-438-8400; fax, 408-
439-9119.

List price: Standard edition (Windows or DOS), \$99.95; upgrade, \$39.95; Workgroup edition, \$495; upgrade, \$79.95

Requires: 4MB RAM, 10MB hard disk space (25MB for full installation), Microsoft Windows 3.1.

In short: QPW 5 features numerous usability enhancements, a dramatic gain in analytical power, and a publish-and-subscribe system for workgroup connectivity.

436 ON READER SERVICE CARD

First Looks

Designer 4.0

CONTINUED FROM PAGE 37

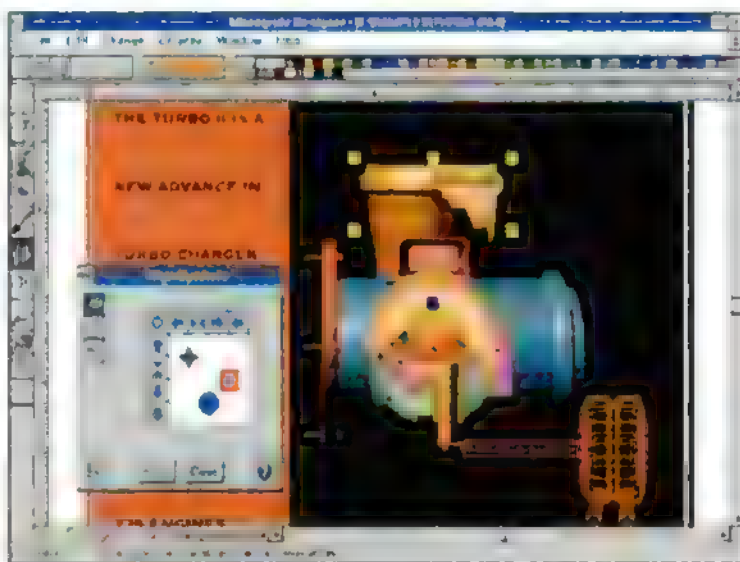
replaced with 3-D buttons, a user-defined toolbar on the left side of the drawing area, and a context-sensitive ribbon bar under the menus at the top. This new interface is much easier to work with than its predecessor. You get a hint line at the bottom that briefly explains a tool or function as the mouse cursor is placed over it; and the program's dialog boxes are easy to understand.

Another improvement is the ability to have several drawings open at the same time, as well as linked duplicate copies. We found that we could often speed up work on complex illustrations by having one window open with a full view for reference while working on a close-up copy in the other.

Another speed enhancement is the buttons that let you quickly control the resolution used to display objects and their fill patterns. A coarse or medium setting can shorten screen draw times. The button changes to indicate the current setting—a good indica-

tion of the detail that went into planning the new interface.

Designer's abilities have been retooled for better handling of text-intensive projects and limited desktop publishing.



NEW DIMENSIONS: Micrografx has added 3-D objects and has good alignment control.

With a full installation from CD-ROM, we obtained 280 True-Type fonts and could have opted for the same typefaces in Adobe Type 1 format. The package also includes Adobe Type Manager 2.1. This latest release supports kerning, leading, linked text frames, a spell-checker, and auto-hyphenation. We were also able to stretch, rotate, and warp text objects without converting them to curves, and then still edit them on-screen as text objects. It would be nice, however, to be able to edit using a dialog box.

Master pages can be used to make sure that all the pages in a drawing have the same style, title, or other repeating elements. You can also override master page settings on individual pages. This version also supports up to 32,767 layers, and you can name and track attributes on symbols. This can be a very handy feature for users creating technical drawings or catalogs. We used it to create a parts lists and were able to sort and locate objects based on their attributes or design characteristics.

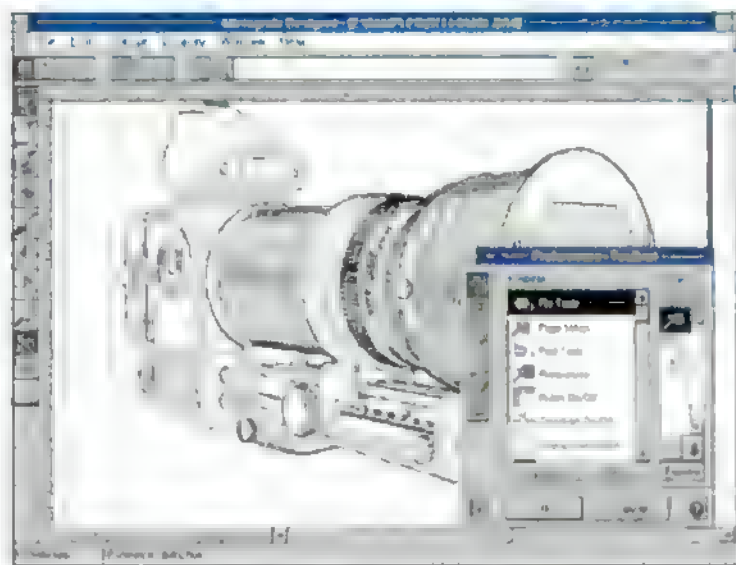
A major addition to Designer's toolkit is the ability to create, fill, and manipulate true 3-D objects. You can use three methods to produce them: Start with a symbol from the 3-D gallery, extrude a 2-D element (including text), or sweep an

existing object around an imaginary axis. In all cases, the result is a fully formed 3-D element that can be rotated and filled. You can also control the angle, intensity, and the quality of the lighting on a 3-D object.

We found it easy to create and manipulate complex shapes. However, you can rotate a 3-D object around only one axis at a time, so controlling perspective takes a little bit of practice.

MORE COLOR

Precise placement and powerful dimensioning capability have always been among Designer's strong points. The new version can handle units of measure as small as one micron and as large as one square kilometer. A micron translates to about 25,400 dpi, about ten times finer than a high-resolution laser photo-typesetting machine. You can also set dimensioning to display custom units of measure and time values such as inches, yards, hours, or weeks. The values are displayed next to the object and change



USERS' DISCRETION: Choose which tools (old and new) appear in the toolbox.

automatically as the object is resized.

Designer's color-handling abilities have also undergone a major overhaul. You can use Pantone, TruMatch, and Focal-Tone color systems to specify shades as well as to create custom color palettes. The program's native, internal color

mode is CMYK (Cyan, Magenta, Yellow, and black).

If you need very sophisticated color output, the SmartSep utility should fit the bill. The controls are easy to use and quite complete. Button bars, sliders, and menus set options ranging from dot type, trapping, and under color removal to black generation and ink correction. You can also place registration marks and color labels, and roughly calibrate your monitor and printer.

The PhotoMagic bitmap editor may not be as full-featured as stand-

alone paint products, but it offers enough tools for the average user. The interface is almost identical to that of other Micrografx apps. We pulled in several images, some using the program's built-in Twain support. Controls include the usual contrast and brightness adjustments, basic retouching filters (paint, clone, smear, and erase), along with fills, mirror, and flip controls, and a variety of special effects. You can also stitch hand-scanned files together and perform Windows screen captures.

Designer also includes about 13,000 pieces of clip art, an image browser, and file-management features for cataloging, organizing, and previewing common bitmap and native .DRW file formats. The

new Designer is still primarily aimed at the intermediate to advanced user, but the new interface and expanded tools will be a hit with more casual users as well. The new 3-D objects abilities up the ante in the illustration software market and prove that Micrografx has not lost its touch. □

FIRST LOOKS PLUS

From October 4 through October 8, you can go on-line to download a demo of Micrografx Designer or to discuss the program with James Karney and Designer product manager Lea Ellermeier. Type GO ZNT EXEC from any CompuServe prompt.

Micrografx Designer, Version 4.0

Micrografx Inc., 1303 Arapaho Rd., Richardson, TX 75081; 800-676-3110, 214-234-1769 ext. 505 (Canada only); fax, 800-994-6457

List price: \$695; upgrade, \$149.

Requires: 4MB RAM, 10MB hard disk space, Microsoft Windows 3.1.

In short: An inviting new interface, 3-D object design, and micron-level unit control have made Designer 4.0 worth the wait.

434 ON READER SERVICE CARD

■ Presentation Graphics

WordPerfect Presentations: Serious Slide Maker

BY CAROL ELLISON

If you think there's little new ground to break in the world of presentation graphics, think again. With all that's packed into WordPerfect Presentations for Windows, it's clear that WordPerfect Corp. intends to establish an immediate presence in a category dominated by Freelance, Persuasion, and PowerPoint with high-end features that are remarkably easy to use.

The \$495 program ships on floppy disks or on CD-ROM (the CD-ROM version is scheduled to ship in October). Anyone with a CD-ROM drive should opt for the CD version—and not just because the full installation consumes 22MB of hard disk space and takes 40 minutes to install. WordPerfect Presentations will let you link objects embedded in your presentation to video and sound tracks on CD. In spite of all that's there, the program is relatively speedy and may be the fastest to learn of all PC presentation products. It's so easy to use, you'll hardly notice the lack of a separate quick-start card.

SLIDE EDITING

WPP starts up in the slide editor, where a master stylesheet awaits you with a title slide template already on screen. Double-clicking on the text box takes you to an edit mode where you can change the template text in an outliner at the top of the screen and see your changes displayed in an image of your slide at the bottom. All text and chart editing takes place in this split-screen fashion.

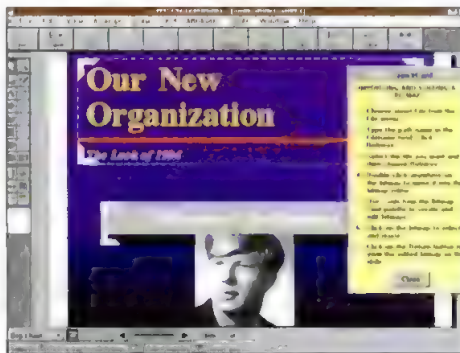
Data chart templates feature

a default worksheet at the top of the screen into which you can enter text or import data from Excel, Lotus 1-2-3, PlanPerfect, Quattro Pro, or ASCII delimited files. The worksheet lets you execute basic formulas to calculate entire rows and columns for totals, averages, and cosines, for

autotrace feature, it's ideal for scanning high-contrast images and line art you want to touch up or convert to drawings.

Many of the innovative and popular features introduced in WordPerfect predecessors can be found here, including context-sensitive button bars that

place often-used tools and features at the top of your screen. There's a context-sensitive right mouse button to pop up additional tools, a QuickFind indexing feature in the File Manager, and shared applications such as the WordPerfect spell-checker that can be used with any WordPerfect product.



BITMAP IMAGES: *The QuickTutor keeps a QuickCard summary on-screen.*

instance, and to fit your data to curves. You can fit your data to a trend line in a linear regression, polynomial, or scatter chart.

WordPerfect Presentations for Windows has some things other presentation programs don't, including editing tools for both bitmap and vector graphics, along with an autotrace to convert bitmaps to vector drawings. You can also scan photos and drawings into your slides from any Twain-compatible scanner.

The scanning functions feature unusually accurate autostitching and rotation features, which automatically pieced together an intricate photograph we scanned in at 200 dpi. However, since WPP has no image-enhancement tools to lighten, darken, de-skew, or solarize the image once it's in the program, it isn't ideal for low-contrast grayscale images. But when combined with the bitmap editor and

EVERY KIND OF HELP

The program shines at making itself accessible to new users. In fact, such aids as the extensive "How Do I..." online help, simple interactive tutorials in the form of QuickTutors, and clear step-by-step instructions and hands-on examples in the Lessons/Quick Solutions manual make it easy for newcomers to create a simple but impressive presentation in less than 15 minutes.

The manual's tutorial will familiarize you with the menus and tools and teach you how to create slides; apply masters; incorporate clip art from the 1,000 images in the gallery; use the outliner; create simple word, data, and organizational charts; sort slides; play a slide show; and save it all in one big file.

There are lessons and tours in how to create drawings and save them in WordPerfect's .WPG graphics format, and in how to enhance screen shows using the more than 30 transitions (including cascading bul-

lets) and 100 MIDI sound files included in the program. WPP supports TrueType fonts and ships with 30 Adobe Type Manager fonts to give you an exhaustive complement of text styles.

The program features interactive point-and-shoot previews for just about anything you'd choose to put in a presentation. Its 60 presentation masters, 8 background templates, and 12 different data chart types (including hi-lo and scatter charts) with their 16 different styles are presented in graphical thumbnail previews that show you what you'll get before you select it. There are also preview modes for the screen show transitions and audio files.

DDE and OLE support bring new dimensions of interactivity and multimedia to your presentations, allowing you to link data and objects, including sound and video clips, to other applications.

WordPerfect Presentations' many learning aids and incredible ease of use, combined with high-end creative tools rarely found in presentation programs, make this product a winner for professionals and newcomers alike. □

FACT FILE

WordPerfect Presentations 2.0 for Windows

WordPerfect Corp., 1555 N. Technology Way, Orem, UT 84057; 800-451-5151, 801-225-5000; fax, 801-222-5077

List price: \$495; additional license (no disks or documentation), \$295; site licenses available for 5 or 20 users; competitive upgrade, \$129 (until December 31).

Requires: 4MB RAM; 9MB hard disk space, Microsoft Windows 3.1.

In short: A variety of helpful learning tools makes WordPerfect Presentations the easiest presentation graphics program to learn, and high-end drawing tools let the artist in you come out.

ON READER SERVICE CARD

FASTEN YOUR SEAT BELTS. THIS DOESN'T RUN ON CLIP ART.

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PCs

VTech Leads in PC Multiprocessing

BY AMARENDRA SINGH

Symmetrical multiprocessing, the art of using an operating system to distribute processing tasks between two or more separate CPUs in a single PC, has come to the desktop. It's something of a surprise, though, that the first vendor to market such a desktop system is VTech Computers, whose fully configured dual-processor Platinum SMP system is priced at an amazing \$3,999.

You can get a Platinum SMP with either a single CPU or dual CPUs, at speeds from 50 MHz (486DX2) to 66 MHz (486DX2). Sockets that will accept the upcoming P24T Pentium overdrive CPU are included.

As a desktop system, the Platinum SMP is attractive. Only the monitor, with considerable

Since each CPU executes a separate portion of a program's code, everything happens faster. While you might assume that a PC with two processors working together would complete tasks twice as fast as a single-CPU system, that's not quite the case. Overhead involved in distributing the tasks and applications not written to take advantage of multiprocessing will slow things down. Under Windows NT, Microsoft claims a performance improvement of up to 70 percent, but our tests showed that figure to be high.

We broke down our various tests into three categories, and the overall results showed an performance improvement that varied dramatically by load. While the results are not completely consistent, they show a

few clear benefits. First, it's clear that the greater the stress on the system, the greater the benefits of symmetrical multiprocessing. Apps like Excel or Microsoft Word for Windows alone won't really benefit.

Second, while the benefits do increase with the greater load, not all types of programs necessarily benefit equally from the presence of the second CPU. Floating-point-intensive apps like

CAD benefit the most. When the CPU load was small, the overhead involved in distributing that load actually caused apps to slow down.

Pricing on the Platinum SMP systems ranges from \$2,199 to \$3,999. The base system comes with a 50-MHz DX2 chip, an ISA/VESA bus, 8MB RAM, an

S3-based VESA local-bus video card, a 340MB hard disk, and a 15-inch monitor. For \$200 more, you get a 66-MHz processor.

For \$2,999 you get an additional 8MB RAM, a 527MB hard disk, and a CD-ROM drive. A system with the second CPU installed will cost you \$3,999. All systems come with DOS 6, Windows 3.1, and a mouse; the dual CPU unit also includes Windows NT.

VTech is positioning the Platinum SMP as an alternative for users who don't want to wait for Pentium systems. Keep in

mind, though, that differences between the 486 chip and the Pentium, such as the Pentium's improved floating-point performance and 64-bit operations, mean that there is still a group of users that will really need the Pentium.

•List price: with 16MB RAM, 527MB hard disk, CD-ROM, 15-inch monitor, mouse, Microsoft Windows NT, \$3,999. VTech Computers Inc., 800 Church St., Lake Zurich, IL 60046; 800-883-2467, 708-540-8086; fax, 708-540-8335.

Circle 435 on reader service card

Performance Tests: VTech Platinum SMP

On our tests, the use of symmetrical multiprocessing improved the performance of the VTech Platinum SMP up to 90 percent, depending on the number and type of processes involved. The greatest gains came on floating-point operations; the smallest, on our Recursive test. The Integer test showed average gains of just over 50 percent. The overall improvement in performance was about 30 percent.

To test the advantages of symmetrical multiprocessing, we ran a series of tests on the Platinum SMP with both one and two 66-MHz 486DX2 processors installed. The line charts show the relative performance improvement for three distinct instruction types: floating-point, integer, and recursive. The results (elapsed time) are plotted for two, four, six, and eight sequential tasks, showing the effect of increased processor load on performance.

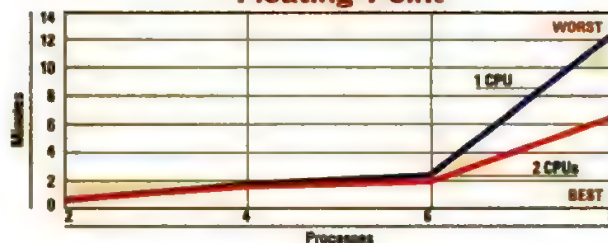


YOUR CHOICE: One processor or two.

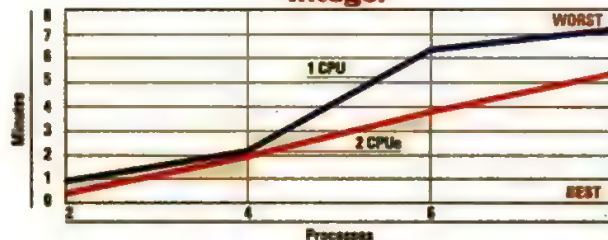
flicker at the default refresh rate, disappoints. Inside the system is an ISA bus with four ISA slots, all of which are free. Two ISA-VESA slots are occupied, one by the Diamond Stealth24 Local Bus Video card, and the other by the additional CPU card.

The benefits of symmetrical multiprocessing are obvious.

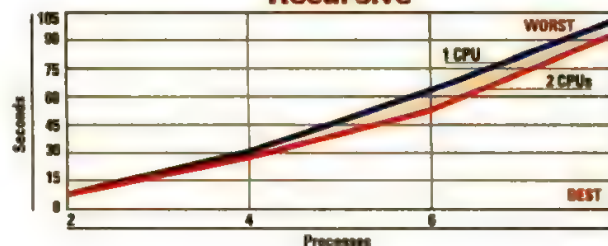
Floating-Point



Integer



Recursive



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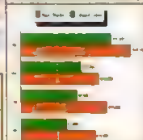
YTD SUMMARY	AMOUNT
Total Number of Bad Checks	8014
Average Daily Balance	-\$41,449.00
Average Amount of Bad Checks	\$19,242.00
Largest Overdraft	\$49,650.00
Outstanding Loans	\$85,320.00
Overdraft Fees (Waived)	\$1,250.00
Interest Owed (Waived)	\$5,360.43

ACTIVITY SUMMARY					
Date	No	Memo/Category	Payment	Deposit	Balance
9/17	5861	The Watergate Hotel	1,555.35		
9/31	5863	The Hair Club For Men	21,510.00		
9/28	5863	Club Med	3,850.78		
4/7	5864	Larry's Lexus Dealer	49,650.00		
4/15	5865	Burning Tree Country Club Annual Dues	10,000.00		
4/17	5866	American Express	23,400.09		

PREVIOUS BALANCE	\$25,623.00	TOTAL PAYMENTS	\$0.00
NEW BALANCE	\$131,053.88	AMOUNT DUE	\$0.00



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CIRCLE 075 ON READER SERVICE CARD

■ File Translation

Replica Challenges Acrobat in Document Viewing

BY LORI GRUNIN

By exploiting the widespread growth of TrueType and GUI environments, Farallon's \$99 Replica aims to be the simplest and most universal product in the emerging category of application-independent document-viewing software. Unfortunately, the product places more burdens on TrueType than that font format can shoulder. The result is a product that is extremely useful, but only in a limited number of ways.

When you "replicate" a document, presentation, newsletter, or any other page-oriented information, you convert it to a format that can be read by any user equipped with the Microsoft Windows or Macintosh version of the product. The version viewed resembles the original as closely as possible.

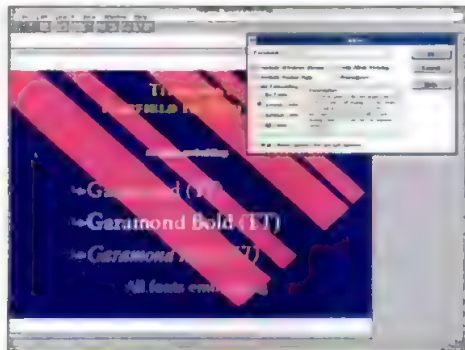
On the surface, the conversion process works similarly to the one used by Adobe Acrobat's PDF Writer (First Looks, September 14, 1993): Replica shows up as a print destination, and you print to it from your application. At the end of the print job, Replica launches. Then you configure your options and save the new .RPL file.

RASTERIZING REPLICATOR

The replicator rasterizes all images and turns PostScript Type 1 fonts into bitmaps (not bitmapped fonts); even if the person reading the document has the relevant Type 1 fonts, Replica can't use them. But vector graphics remain vector, and all text formatted using TrueType remains live text that you can search across or copy to the clipboard.

The way in which Replica

handles the text formatting depends upon the choice you make when saving the .RPL file and the embedding possibilities that the font vendor has enabled in its font. You can, for example, choose "All fonts," which will embed screen, printer, and TrueType fonts for all characters used in your document. Choosing "Optimal fonts," on the other hand, embeds screen, 300-dpi printer, and nonstandard TrueType fonts (those not included with Windows). You



EMBEDDING OPTIONS: Replica takes advantage of TrueType's font-embedding capabilities.

can also choose to have only screen fonts embedded, or no fonts at all. The ability to include a viewer executable (with or without the help file), which lets you freely distribute documents, is one of Replica's best features.

A six-slide, text-only PowerPoint presentation using mixed Type 1 and TrueType fonts yielded files that ranged from 12K (no fonts embedded) to 493K (screen fonts, viewer, and help embedded); the original file takes 17K. Similarly, a 6-page, text-only Word for Windows document formatted with Type 1 headlines and TrueType body text resulted in a 38K Replica file; the Acrobat file only took up 25K.

The program also offers password protection on a file-by-file basis; an "only allow viewing

option" that disables the cut and paste functions for a given document; and mail enabling, which launches your VIM- or MAPI-compatible electronic-mail software (such as Lotus cc:Mail or Microsoft Mail) and attaches the document to a new message. You can zoom the view of a document at preset levels ranging from 25 percent to 400 percent, in either a single-page or a double-page layout.

TOO TRUE TO TRUETYPE?

If the fonts used in the source document are print-and-preview or installation-enabled, then you'll certainly get your \$99 worth out of Replica. Unfortunately, things can still get really

ugly, even under these optimal conditions. For instance, at viewing time your colleagues can remap any of the fonts within the document to fonts on their systems, but the font-mapping rarely works properly. Since Replica documents are rasterized to 96 dots per inch (approximately equivalent to 800-by-600 resolution) and maintain the line breaks as they occur in the original document, the replacement

font you choose has to be squashed, stretched, or otherwise contorted to fit the metrics of the original. This doesn't just look bad—overlapping characters and bizarre character spacing can make it unreadable. An auto-justify option for text occasionally works to fix overlapping characters.

If a font doesn't allow embedding at all (the most realistic discovery method is trial and error) Replica creates a bitmap version of it (although it still preserves the actual text). The bitmapped text

FACT FILE

Replica for Windows, Version 1.0

Farallon Computing Inc., 2470 Mariner Square Loop, Alameda, CA 94501; 510-814-5000; fax, 510-814-5020.

List price: \$99; 10-pack, \$749.

Requires: 2MB RAM, (4MB recommended), 1MB hard disk space, Windows 3.1.

In short: Replica converts documents to a format readable by any system, no matter what fonts are resident, but the TrueType technology it uses isn't quite up to the challenge.

ON READER SERVICE CARD

displays very slowly—even on a 66-MHz 486 system with accelerated local-bus graphics—and Replica redraws all visible pages when you scroll. Combined with the lack of an interruptible redraw, it's enough to make you swear off using non-embeddable fonts.

The program also lacks a custom page-size option in the print dialog. Without it, you can't create screen-sized pages, only paper-sized pages—a real flaw in an on-screen viewer utility.

MOVING BACK AND FORTH

Navigating long documents is also a hassle. Replica lets you perform single-word searches, as well as move backward, forward, or to a specific page. But without thumbnails, an outline of section headings, or some form of collapsed document view, there is no way to move around randomly unless you already know what the document contains.

Replica is better at solving the application-dependence problem than it is at solving the font problem, but for users distributing short documents it does a good job, and it does it more inexpensively than Acrobat can. □



You can go on-line to download a free trial version of the Replica for Windows Viewer and a limited version (five documents) of the Replica Creator utility. Type GO.ZNT.EXEC from any CompuServe prompt and look for the file REPWIN.ZIP in Library 15, Demos Showcase.

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MicroScan Model	2E	3E	3E+	3G	4G	5A
CRT Size	14"	14"	14"	14"	15" FS	17" FS
Dot Pitch (mm)	0.28	0.28	0.28	0.28	0.28	0.26
Active Display Size (mm) *	267x200	267x200	267x200	267x200	280x210	316x237
H-Frequency (KHz)	30-38	30-50	30-58	30-64	30-64	30-64
Vertical Scanning (Hz)	50-100	50-100	50-100	50-100	50-100	50-100
VESA 640x480@72Hz	•	•	•	•	•	•
VESA 800x600@56/60Hz	•	•	•	•	•	•
VESA 800x600@72Hz		•	•	•	•	•
VESA 1024x768@60Hz		•	•	•	•	•
VESA 1024x768@70/72Hz			•	•	•	•
1280x1024@60Hz				•	•	•
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CIRCLE 226 ON READER SERVICE CARD

■ Fax Software

FaxWorks 3.0: An Easy Way To Get Your Message Across

BY EARLE ROBINSON

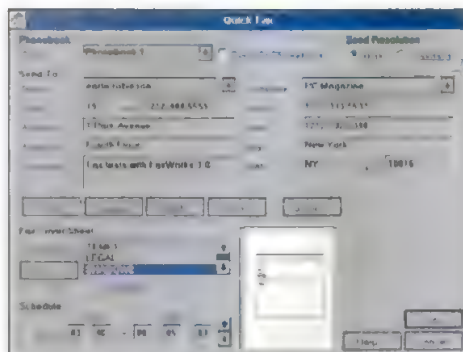
With its comfortable interface and well-designed installation procedure, SofNet's upgrade to its Windows-based fax program, FaxWorks Pro 3.0 (\$129.99; upgrade, \$49), is a completely rewritten program that gives its main competitor, Delrina's WinFax Pro, a run for its money. FaxWorks includes the Calera OCR engine, Twain scanner support, and a DOS TSR program for faxing from DOS applications, too.

Tight integration of phone books, fax logs, and the cover page repertoire in FaxWorks'

help manage your faxes. Many cover pages are available, and you get drawing tools to design your own, too. Over 200 clip-art files allow you to add a little levity to cover sheets, or even to faxes themselves.

You can forward incoming faxes to another location, a useful way of keeping in touch when you're away from your office, and you can import phone books from WinFax Pro, Faxit, ACT!, or as text or .DBF files.

You also get a multipage thumb-



FAX OUT: Sending faxes is quick.

FaxTracker makes the program easy to use. Incoming faxes are compressed to save disk space, and there's a folder feature to

mail view of incoming or outgoing faxes. Individual pages in this view can be reordered, inserted, or deleted.

Enhanced dialing options permit the sending of dial-out access numbers, input account codes, and options. This feature also facilitates ready retrieval of fax messages from fax mailboxes and the use of faxback services.

The only major weakness we found in FaxWorks was the modem recognition routine, which failed to recognize a U.S. Robotics Courier modem and improperly identified a Practical Peripherals modem.

SIMPLE TO START

FaxWorks has Macintosh-like balloon help messages, called cue cards, providing details of what each button or menu item offers. They can be turned off once you learn the program. Context-sensitive help messages are also visible across the bottom of the screen whenever the mouse cursor is on a button or icon. The on-line help provided with the package is very complete and thoroughly covers all aspects of the program.

Automatic registration of FaxWorks, through a toll-free number, happens during installation. You can even call SofNet's fax line and obtain new technical documents.

Program updates will also be offered by fax, using a file transfer protocol directly to the program. The fax line will be used to diagnose any problems you may encounter, transferring special debugging files back for analysis by SofNet's technical support team.

FaxWorks 3.0 Pro has the most easily mastered interface of any fax program we've seen. With its competitive price and all its integrated features, FaxWorks 3.0 Pro merits the success it will achieve.

• List price: *FaxWorks Pro, Version 3.0*, \$129.99; upgrade, \$49. Requires: 4MB RAM, 5MB hard disk space, Windows 3.1, fax modem. SofNet Inc., 380 Interstate North Parkway, #150, Atlanta, GA 30339; 404-984-8088; fax, 404-984-9956.

Circle 416 on reader service card

■ PC Upgrade

Cyrix Cx486DRx2: Instant 386-to-486 Upgrade

BY STAN MIASTKOWSKI

Users of 386-based systems often feel left behind as the world inexorably moves toward the 486 standard, especially when personal or corporate budgets won't cover the cost of a new 486-based system. Cyrix has an answer; a one-chip 486 upgrade for PCs based on Intel's 16-, 20-, or 25-MHz 386DX processor. With prices ranging from \$399 to \$499—depending upon the speed of your existing processor—the Cx486DRx2 delivers clock-doubled 486 compatibility and performance at a reasonable cost.

Cyrix's solution is simple. You remove the existing 386 chip from its socket, plug in the Cx486DRx2, and run some software.

With most systems, the upgrade should be an easy 15-minute job. The 25-MHz 386-based Gateway 2000 system we upgraded had its processor right out in the open, requiring only

the temporary removal of a full-length add-in board to enable easy access to the socket.

Once you get to the chip, you use tools provided by Cyrix that make removing the 386 a breeze.



NEW BRAIN: Cyrix upgrades start at a reasonable \$449.

It's important to press the new chip in firmly, as we found out when nothing happened the first time we turned the system on. It's also important to note that the Cx486DRx2 runs a lot hotter than a 386 and even comes with

a stick-on heat sink that Cyrix recommends you install.

Two utilities added to your AUTOEXEC.BAT file (neither are memory resident) turn on the chip's internal 1K cache and enable a unique fast I/O feature that boosts video and disk operations. Because 386 motherboards aren't designed to work with on-chip caches, Cyrix uses a patented "cache coherency" technology that provides data integrity between the chip's cache and the system memory.

The Cx486DRx2 doesn't include a math coprocessor, although Cyrix will sell you one to match the new chip. It won't work with 386SX-based PCs, and a version isn't available for 386DX/33-based systems. Cyrix performed compatibility tests, and the chip has been approved by both Microsoft and Novell.

• List price: *Cx486DRx2* 16/32, \$399; 20/40, \$449; 25/50, \$499. Requires: *PC with motherboard using an Intel 386DX processor running at 16, 20, or 25 MHz.* Cyrix Corp., 2703 North Central Expressway, Richardson, TX 75080; 800-462-9749; fax, 214-699-9857.

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CIRCLE 306 ON READER SERVICE CARD

■ Integrated Software

Lotus SmartSuite 2.1: Tight 5-in-1 Integration

BY GREGG KEIZER

Lotus Development Corp.'s \$795 SmartSuite 2.1 for Windows, a five-in-one bundle of Lotus 1-2-3 Release 4.0, Ami Pro 3.01, Freelance Graphics 2.01, Lotus Organizer 1.0, and Approach 2.1, goes further than any other "suite" or "office" software collection in addressing thorny integration issues.

Users of Lotus Notes will appreciate the enhancements integral in three of the SmartSuite applications. The versions of 1-2-3, Ami Pro, and Freelance included here can now store their files and output in Notes databases; later, they can pass the subject, author, size, date, and style of each object to Notes. Notes-equipped users can simultaneously edit 1-2-3 spreadsheets, use Ami Pro as a Notes text editor, or create a Freelance presentation from within Notes.

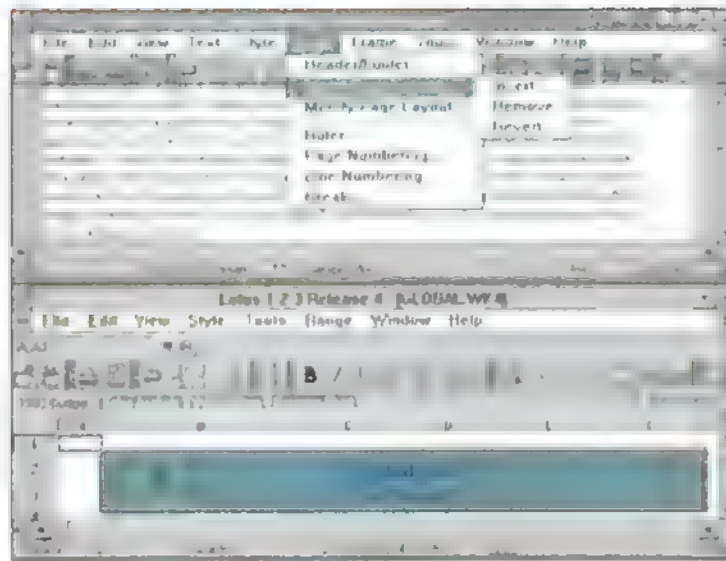
SmartSuite's integration isn't strictly for Notes aficionados, though. More than two dozen SmartIcons, the customizable toolbar icons Lotus has promoted in its applications, are common to the suite's applications, and menus in the SmartSuite applications are consistent.

But it's the addition of the Working Together Bonus Pack that ties together these programs in ways beyond the typical cut-and-paste, DDE, and OLE operations of Windows. Mostly macro-based, the nearly 30 utilities in the Pack install to Ami Pro, then smooth integration between the word processor and the other components. One macro, for example, places a five-button application launch bar at the top of the screen, while another tiles two applications horizontally or vertically.

Others collect multiple ranges of 1-2-3 data or several Freelance slides and place them

on a single Ami Pro page, insert a Freelance organizational chart into a Ami Pro document, print a month's worth of Organizer appointments within Ami Pro, and automate presentation making from within the word processor.

Although the Working Together macros work as adver-



WORKING TOGETHER: The launch bar (upper right) is a special SmartSuite feature.

tised, some integration elements are less effective. Paste a 1-2-3 chart into Freelance, and you

have to manually reformat it for the slide's style.

With its capable software set, enhanced Notes access, and connective macros, Lotus SmartSuite 2.1 is the most tightly integrated bundle you'll find.

• List price: *Lotus SmartSuite 2.1 for Windows*, \$795; upgrade, \$595. Requires: 4MB RAM, 24MB hard disk space, Windows 3.0 or later. Lotus Development Corp., 55 Cambridge Pkwy.,

Cambridge, MA 02142; 800-343-5414, 617-557-8500.

Circle 424 on reader service card

■ Image Capture and Conversion

Graphics Tools! Handles All Your Imaging Needs

BY BARRY SIMON

DeltaPoint's \$169.95 Graphics Tools! joins a quickly growing group of image manipulation tools that includes Collage Complete, HiJaak PRO, and ImagePals. Unlike some of those other packages, it tries to be all things to many users, and to a great extent, it succeeds.

Graphics Tools! revolves around Media Manager, the place where you create catalogs of images and from which you activate the program's components: Image Tools, Image Processor, Convert, and Capture.

The catalogs you make in Media Manager can contain a wide variety of bitmapped and vector graphics as well as Autodesk Animator and QuickTime movies. You can assign a name and keywords to images and search for them, and particularly welcome is the program's ability to search subdirectories to mark items in a catalog and then browse through them.

Dragging and dropping images from Media Manager into other applications is possible, but you can't open multiple catalogs to drag and drop among them as you can in ImagePals.

Creation of thumbnail views is slower than in ImagePals, too (for some file types, by a factor of ten).

Conversion capability is especially strong in Graphics Tools!. Not only can you convert between standard bitmapped formats, between standard vector formats, and from vector to bit-mapped formats, but Image Tools includes an auto-trace feature to convert from bit-mapped to vector formats. In our tests, most conversions went well and the autotrace performed admirably, but there were some EPS files that Graphics Tools! could not read or convert, even though HiJaak could.

The screen-capture utility lets you capture the entire screen, active windows, a selected area, or a selected window.

The Image Processor works only on bitmap images. It lets you change brightness and contrast or apply filters such as

sharpen and despeckle. There is a set of image editing tools, but it's underpowered compared to PhotoFinish and PhotoMagic, the best low-end image editors.

Graphics Tools! isn't quite as good as ImagePals in screen capture and cataloging nor quite as solid as HiJaak in conversions, but it's close in those areas, and that makes it a great overall graphics manipulation package if you use all the tools it offers.

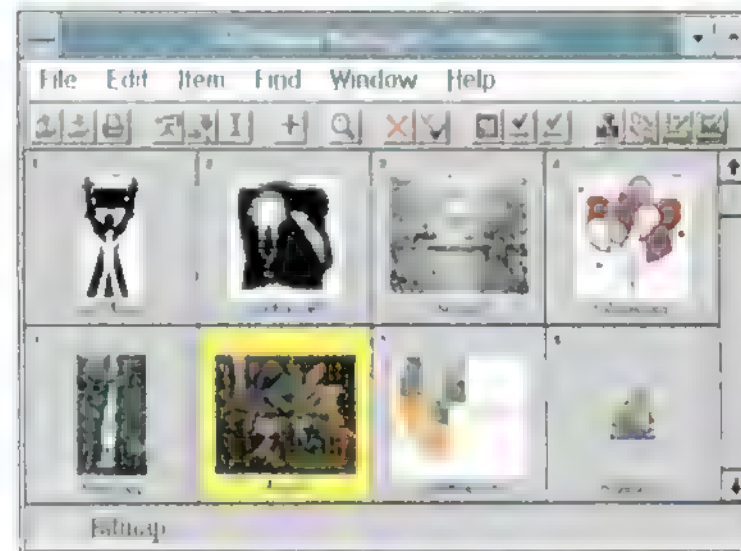


IMAGE CATALOG: Graphics Tools! can view eight different file formats.

• List price: *Graphics Tools!, Version 1.0*, \$169.95 (\$99 introductory price; \$69 for users of other DeltaPoint products). Requires: 2MB RAM, 4MB hard disk space, DOS 4.01 or later, Windows 3.1. DeltaPoint Inc., 2 Harris Ct., #B-1, Monterey, CA 93940; 800-446-6955, 408-648-4000; fax, 408-648-4020.

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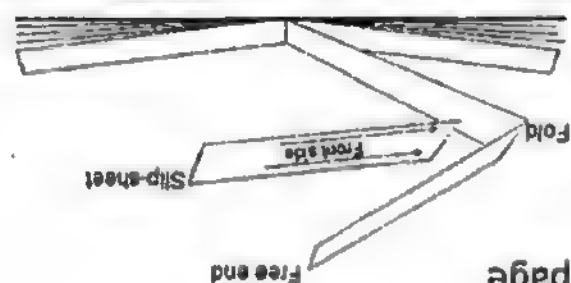
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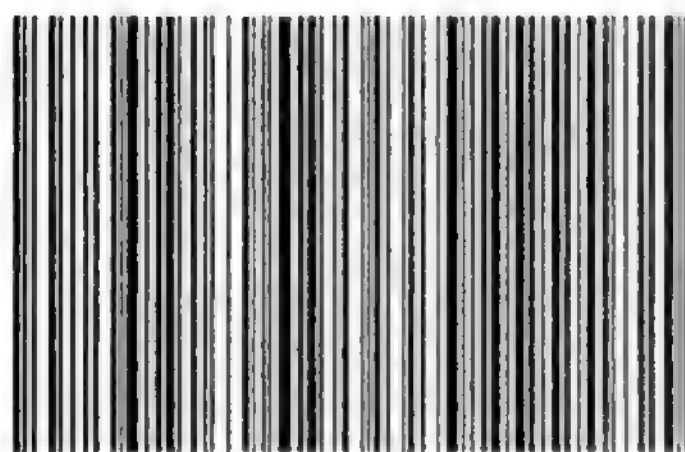


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2. Insert this sheet with
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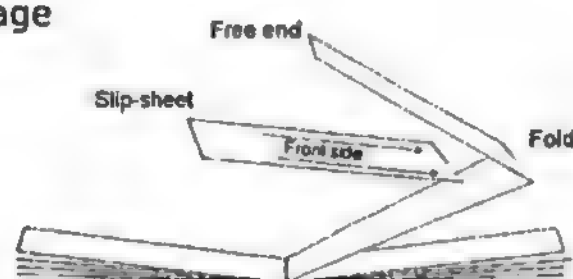
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Foldout slip-sheet

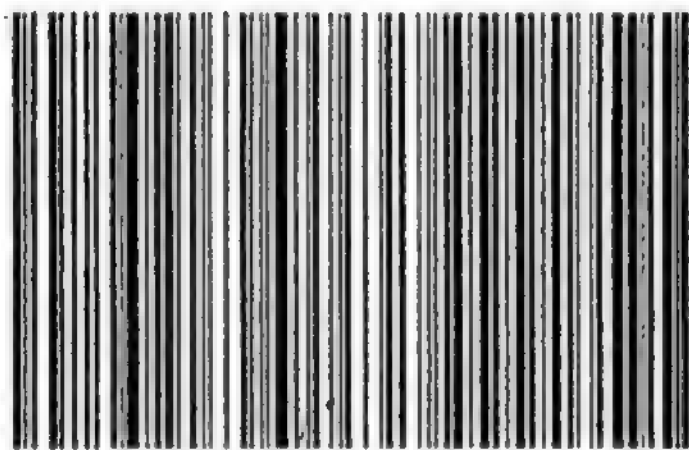
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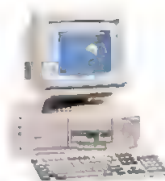


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Circle 155 on reader service card.

■ On-Line Utilities

Journalist Delivers Your Own Personalized Newspaper

BY JOHN R. QUAIN

Journalist, Version 1.1, can bring a timely, personalized electronic newspaper to your desktop—and it doesn't even need to be recycled. The \$129.95 Windows-based package accesses CompuServe to fill a customized newspaper layout that you can update with one mouse click.

By using toolbars and setup pages, you can create an electronic paper tailored to your specific interests. Pulling news from services like the Associated Press, Journalist presents you with a standard newspaper page display. You specify the contents of each frame, and Journalist automatically dials up and pours the news into your layout: football on page 1, Washington politics on page 7. You can update the entire paper or choose an individual frame for time-sensitive information.

If you don't use any of CompuServe's premium services, it will cost you about \$3.50 in on-line charges to do your own seven-page newspaper (Journalist warns you about excess charges). You can expand your newspaper to retrieve information from other wire ser-

vices, including Reuters, UPI, and the Washington Post.

SLOW DOWNLOAD

We created a paper that included three weather maps, a customized list of stock prices, sports, business, science, entertainment, and national news. It took 16 minutes to download at 2,400 bps. The program runs smoothly in the background, and you can reduce the download time by using a 9,600-bps modem. However, Journalist relies on slower text and Xmodem communications protocols rather than faster B+ and Zmodem modes. (PED plans to support B+ and Zmodem protocols this fall.)

To set up a basic personal newspaper takes about 40 minutes. If you don't like the default fonts, you can use any TrueType or PostScript fonts already on your system, and the size of individual category frames can be adjusted, along with headline and body text sizes for easier reading.

Journalist does have its limitations, though: You can't preview printouts; there's also only one basic type of chart for following stock prices; and your

paper can't exceed 128 pages.

Journalist 1.1 still has the earmarks of new product, lacking a certain degree of maturity and smoothness. For example, if you open Journalist ahead of other programs in Windows, it can hog memory. And if you have anything but a strictly Hayes-compatible modem, you may have to customize the communications settings. PED plans to eliminate these nuisances in a fall release,

but they're forgivable in an exciting, truly new product that brings one vision of the future into the present.

• List price: *Journalist, Version 1.1*, \$129.95. Requires: 4MB RAM, 5MB hard disk space, Windows 3.1. PED Software Corp., 1340 Saratoga-Sunnyvale Rd., #203, San Jose, CA 95129; 800-548-2203, 408-253-0894; fax, 408-253-1062.

Circle 418 on reader service card

■ SCSI

Adaptec's New SCSI Cards Are Cheaper, But Not Faster

BY JAMES KARNEY

Adaptec is retiring its 1740 series EISA bus-mastering SCSI host adapters, replacing them with a state-of-the-art group of adapters that have options that will leave few mourning their predecessors' departures. The Adaptec AHA-2740 series adapters are based on an 8-MIPS RISC engine. They feature easy jumperless installation, have a higher mean time between failures, and come in Fast, Wide, and twin-channel versions.

The new adapters are about \$100 less than the ones they replace. A 2742T SCSI Master Plus Kit containing a twin-channel card with built-in floppy disk controller (supporting up to 2.88MB drives); ASPI (Advanced SCSI Programming Interface) drivers; and utilities for DOS, OS/2, Unix, and NetWare costs \$499. Twin SCSI channels on the same card let you connect up to 14 ASPI-compatible devices.

The core of the design is Adaptec's AIC-7770 RISC SCSI engine. This chip can off-load SCSI processing and reduces the number of interrupt calls that must be handled by the host CPU, but while this should improve overall SCSI bus performance by about 15 to 20 percent, our informal testing didn't show it. The new design does radically reduce the size and

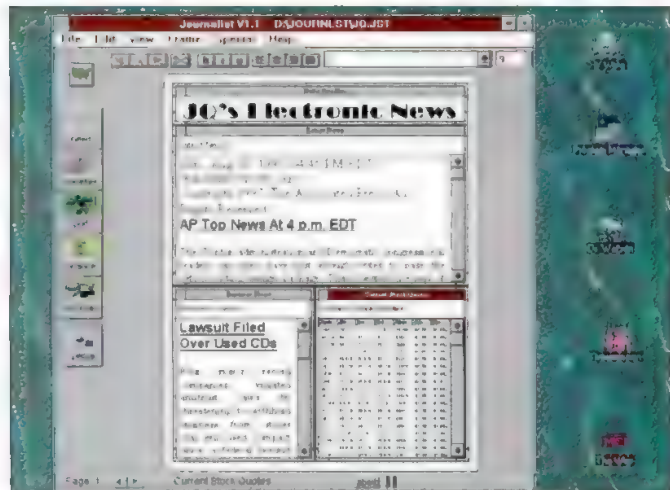
chip count, compared with the older full-slot 1740 series. There are less than half the parts on the 2740 series half-slot card.

We tested a single-channel AHA-2740 adapter in a DOS/Windows environment and an AHA-2742T in a NetWare 3.11 server. Both 66-MHz 486 systems had Micronics motherboards with 16MB RAM, and had existing ASPI-based host adapters installed before the testing. Both had a mix of SCSI devices, and the Novell system had three IBM/AdStar 662 1GB Fast SCSI-2 drives installed as a Level 5 RAID system.

Setting up the new cards was easy. We ran the EISA configuration program and used Adaptec's EZ-SCSI software on the DOS unit and CorelSCSI Pro on the server to set up the other devices. CorelRAID ran on the 2742T, without modifications other than loading the card's ASPI module and editing the related start-up file entries. A mix of large and small file loads showed throughput that was almost identical to that before the new adapters were installed.

• List price: *AHA-2742T Plus Kit*, \$499. Requires: EISA PC with free EISA bus-mastering slot, ASPI-compatible SCSI device. Adaptec Inc., 691 South Milpitas Blvd., Milpitas, CA 95035; 800-934-2766, 408-945-8600; fax, 408-262-2533.

Circle 419 on reader service card



THE FRONT PAGE: Your Journalist paper has news you choose.

■ Voice Control

Talk Back to Your PC with VoiceType Control

BY JOE SALEMI

Multimedia has given our PCs the ability to talk to us, and now we're starting to see products that let us talk back. IBM's VoiceType Control for Windows is a prime example. It doesn't transcribe what you say; rather, it processes spoken equivalents to many Windows commands. The \$129 package includes software and a Sony F-VX300 microphone. You supply a Sound Blaster or compatible audio board.

Installation is simple: You just run the setup program and plug the included microphone into the mono input port on your sound card. VoiceType Control supports multiple users on the

same machine, so the first step is to tell it who you are.

A quick-training option lets you teach VoiceType Control your pronunciation of the basic commands, which it calls the "always active" vocabulary. VoiceType Control is very sensitive to how the control words are pronounced. The program defaults to a clear, accentless pronunciation that won't match the way the majority of users talk. You'll want to go through the training to ensure that you don't have problems with the basic vocabulary.

Once the basic

vocabulary is established, VoiceType Control leaves a Voicebar active on the screen. The Voicebar lets you toggle the microphone on and off, change users, and reopen the quick-training option. You can also open a window that shows the currently active vocabulary.

In addition to the basic commands, VoiceType Control includes vocabularies for a number of Windows utilities such as Notepad, Calculator, and File

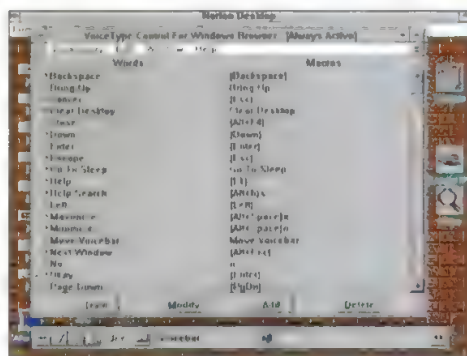
Manager, as well as for several Windows applications.

VoiceType Control usually works well, but it's very sensitive to pronunciations and, to a certain extent, to background noise as well. It usually won't recognize a command on the first try if you don't pronounce it exactly the way you did when you were training it.

VoiceType Control won't replace a mouse and keyboard; it's designed to supplement them. When it understands what you've said, it's very quick in carrying out your commands, but it may be hard to use in a very noisy environment.

• List price: *VoiceType Control for Windows*, \$129. Requires: 2MB RAM, 6MB hard disk space, DOS 5.0 or later, Microsoft Windows 3.1, Sound Blaster or compatible sound card. IBM PC Co., Route 100, Maildrop 3426, Somers, NY 10589; 800-426-2968.

Circle 431 on reader service card



SPEAK UP: The Browser lets you add words to VoiceType Control's vocabularies.

■ Video Utilities

AnyView Changes Resolutions on the Fly

BY DAVID HASKIN

Binar Graphics' AnyView 1.0 is a surprisingly useful video enhancement utility that lets you switch Windows video resolutions without restarting Windows. However, in testing, this \$99.95 time-saver was a little finicky about the hardware and software with which it would work well.

AnyView installs a "master" video driver designed to work with your specific video adapter. Once installed, the AnyView driver lets you switch among video resolutions simply by clicking a button. While most AnyView master drivers are limited to a top resolution of 1,024-by-768, Binar claimed it will soon upgrade the master drivers to accommodate resolutions as high as 1,280-by-1,024.

AnyView also includes three other utilities. Its virtual desktop utility makes your usable

Windows desktop space larger than your screen. You pan through AnyView's enlarged desktop with your mouse. (Most virtual desktop utilities provide a series of screen-sized desktops that you switch among.)

The DPI Wyzard lets you set

the number of dots per square inch that appear on-screen, a helpful tool for WYSIWIG fanatics who want an on-screen inch to equal an inch on the printed page. A third utility zooms in on specific screen elements.



WYSIWYG TOOL: The DPI Wyzard lets you set the number of dots per square inch that appear on-screen.

Though clever and useful, AnyView is overly sensitive to different versions of video BIOS and other software. AnyView crashed during installation when confronted with Version 1.10 of the video BIOS for a Diamond Stealth Pro video adapter, but it worked perfectly with an identical board and Version 1.11 of the video BIOS. With an older Diamond Stealth board, AnyView installed properly but Windows would not load because of share violations. AnyView worked well with two other adapters we tried; both were based on Paradise chips.

AnyView didn't work with QEMM 7.0, however. Binar Graphics said that QEMM could be tweaked to work with AnyView but wouldn't guarantee reliability.

• List price: *AnyView, Version 1.0*, \$99.95. Requires: 1MB RAM, Microsoft Windows 3.0 or later. Binar Graphics Inc., 30 Mitchell Blvd., San Rafael, CA 94903; 800-228-0666, 415-491-4182; fax, 415-491-1164.

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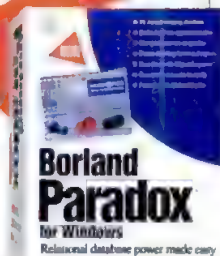
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■ Communications

E-Mail Connection Tackles Multiple Mailbox Dilemma

BY GREGG KEIZER

Imagine that half a dozen mailboxes sat at your curb, one for each of the six separate carriers that dropped off your mail. Or don't imagine. Just deal with your electronic mail.

An all-in-one e-mail gathering program still eludes us, but Connect Software's E-Mail Connection is a step in the right direction. This \$99 Windows program deals directly with a limited number of external e-mail services as well as with internal network e-mail.

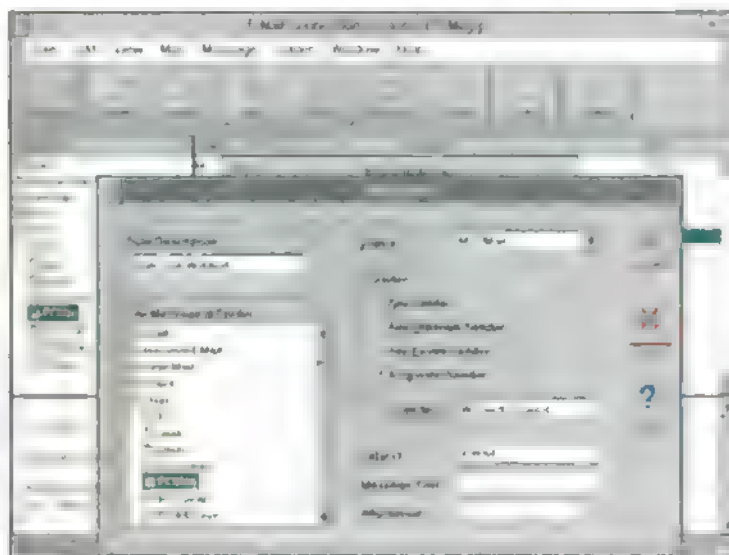
E-Mail Connection connects directly to both MCI Mail and CompuServe's mail so that you can send and receive messages on either system without resorting to intermediate gateways. To reach people on other services—

Prodigy, AppleLink, America Online—E-Mail Connection uses Internet gateways on either MCI or CompuServe. Fortunately, E-Mail Connection uses an intelligent routing system that handles the cumbersome addressing of such mail for you. Sending mail to such addresses is easy, but since E-Mail Connection doesn't poll these unsupported services, receiving mail requires additional software or appropriate Internet addressing by your correspondents.

E-Mail Connection also handles network electronic mail, sending and receiving messages through either MAPI or MHS mail servers. The latter requires that you have Novell

Connectivity Manager.

Like most e-mail packages, E-Mail Connection lets you schedule polling times, keep an address book, build customized distribution lists, reply to and forward messages, and quickly compose and read mail. Other features, though less traditional, are more impressive. You



MAIL ROUTE: Rules let you designate destinations for incoming messages.

can create a variety of user-defined folders to store messages, then develop a set of rules that tell the program where to deposit received mail.

The program's search mechanism is also excellent.

For all its convenience, this first version shows some immaturity. A bug prevents you from creating a rule that tags incoming mail from unknown correspondents, and the connection to MCI Mail, currently limited to 2,400 bps, is unacceptably slow, with actual throughput typically no better than 400 to 500 bps (Connect Software and MCI are working on a fix.)

With little real competition, E-Mail Connection is the default champion of e-mail collectors, even though it doesn't handle messages from every service.

• List price: *E-Mail Connection, Version 1.0*, \$99.95. Requires: 4MB RAM, 4MB hard disk space, Microsoft Windows 3.1. Connect Software, 6742 185th Ave. N.E., #150, Redmond, WA 98052; 206-881-8251.

Circle 429 on reader service card

■ Document Conversion

Conversions Plus: Cross the Mac Divide

BY J.W. OLSEN

If you share files with Macintosh users, they probably handle the compatibility chores for you with the popular MacLink products from DataViz. Now you can return the favor. DataViz has released Conversions Plus for Windows, a \$169 software-only solution that exploits hardware-level compatibility between the 3.5-inch, high-density drives of Macintosh and IBM-compatible systems.

Conversions Plus is two utilities in one, transferring files between Macintosh and DOS disks and translating between word processor file formats. You can access these features separately or simultaneously with a single mouse click.

For files arriving on a native Macintosh disk rather than via a network, modem, or DOS disk, you'll value Conversions Plus's transfer feature, but it will work only if you have a 1.44MB drive, the Mac has a 1.2MB drive, and

able rotation-speed technology, so IBM-compatible products that access them generally require an expansion card. The process works for translating in the DOS-to-Mac direction, too, but your intended recipients must supply Mac-formatted disks.

Conversion Plus recognizes formats of specific versions of 4 Macintosh and 12 DOS and Windows word processors. (Ami Pro and older versions of MultiMate are read-only, however. You can convert from them, but not to them.)

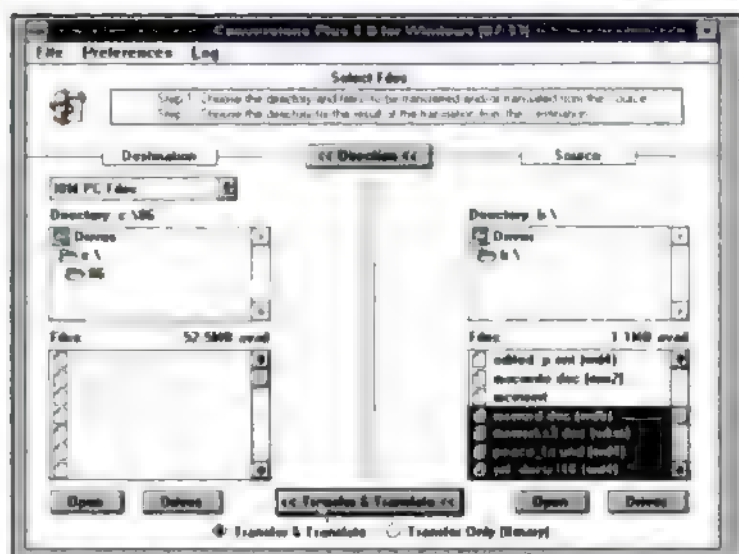
With its combinations of source and destination formats, Conversions Plus sparkles, automatically determining formats and retaining challenging text and layout characteristics. Conversions Plus isn't a total

solution, though. The number of supported word processors and versions is limited. Also frustrating was the fact that with some older files (versions whose Macintosh word processors were unknown), Conversions Plus thought it recognized the formats but failed in translation.

The weakest aspect of conversion is embedded graphics, which are discarded unless their formats are .WMF for the IBM-compatible word processor and PICT or PICT2 for the Macintosh. Future releases of Conversions Plus would do well at least to transfer graphics as independent files that you can convert with third-party products and insert into the text.

• List price: *Conversions Plus for Windows, Version 1.0*, \$169. Requires: 2MB RAM, 2MB hard disk space, Microsoft Windows 3.0 or later. DataViz Inc., 55 Corporate Dr., Trumbull, CT 06611; 800-733-0030, 203-268-0030; fax, 203-268-4345.

Circle 430 on reader service card



EASY DOES IT: Select files and directory, then just click to transfer and translate.

the transfer disk is formatted as high density. Lower-density Macintosh formats employ vari-

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■ Communications

AT&T's PassageWay Connects PCs to Phones

BY JOHN R. QUAIN

When computer software makes it easier for you to program your phone, you know the PC industry is maturing. Compared with simple PIM auto-dialing utilities, AT&T's \$360 PassageWay Solution is a more intimate coupling of PC, phone, and PBX technology that can take the mystery out of multifunction phones.

Although it currently works only with AT&T Merlin Legend phone and PBX systems, PassageWay brings the worlds of telephone and desktop computers closer together by enabling your PC to communicate with office telephone equipment.

Using Windows-based software, Merlin users can reprogram phones and receive such Legend messages as caller ID information, which can then be linked with customer account information.

The PassageWay software and hardware package includes a small serial port adapter, a modular phone cable to connect it to a Merlin phone, and four basic Windows software utilities. It works with Merlin Legend MLX-28D, MLX-20L, and MLX-10DP phones, and connecting the adapter takes only a couple of minutes.

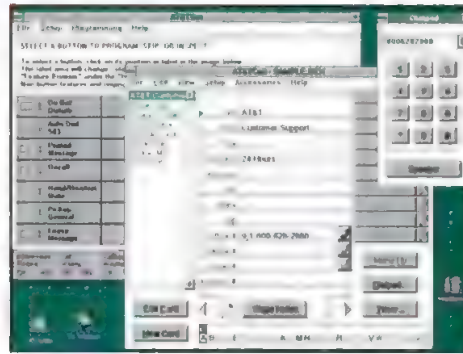
There are four utilities: Connect, Call, Set, and Log Viewer. Running in the background, AT&T Connect communicates with the phone and PBX, letting you test the adapter, change COM ports, and configure the software.

AT&T Call is an auto-dialing address book that uses a flip-up address book metaphor. The utility includes a dial pad, quick-dial buttons, a timer, and linked note files. You can import address and account information from other applications that use .CSV files (comma-separated

values format) and automatically log all calls.

The Log Viewer utility holds up to 8,000 listings. Entries can be deleted after a specified number of days or stored in permanent record files. You can also sort call entries according to name, phone number, account number, time, or date information.

Finally, those who find their phones more difficult to program than a VCR will appreciate AT&T Set. It scans your Merlin



OFFICE MARRIAGE: Connect phone and PC.

phone to see what features it has and lets you program or reprogram buttons by clicking on a menu of automated features.

AT&T has opened up PassageWay's specifications to encourage software vendors to hook in to its features via DDE.

We used preliminary versions of the OnTime business calendar and Commence information manager to test PassageWay, and both programs worked well. Although it's currently restricted to AT&T business phone systems, PassageWay gives users a glimpse of the communications horizon.

• List price: *PassageWay Solution, Version 1.0*, \$360. Requires: 2MB RAM, 2MB hard disk space, Windows 3.1, serial port, AT&T Merlin Legend phone system. AT&T, Room 2B502, 200 Laurel Ave., RM 4E501, Middletown NJ 07748; 800-247-7000, 203-434-3961; fax, 203-294-0835.

Circle 426 on reader service card

■ Hardware

Sharp's Flat Screen: Thin, Bright, \$8,000

BY TIN ALBANO

Flat-panel displays are attractive alternatives to regular monitors because they take up little space, are lightweight, low-powered, and emit negligible amounts of radiation. Currently the color, contrast, brightness, and resolution quality of these displays are unable to match those of desktop monitors, but recent advancements in Liquid Crystal Display (LCD) technology, like those implemented in Sharp Electronics' \$7,995 QD-100MM, are bringing us closer to the day when flat-panel displays will replace today's monitors.

Most flat panels on the market are LCD-based and are found primarily in portable computers. These work by alternately blocking and transmitting light with liquid crystal cells that are opaque or translucent, depending on whether or not an electrical charge is applied to the cell.

Active-matrix LCDs are the most coveted flat-panel displays because each pixel in the screen

has a dedicated transistor that turns it on and off, allowing for fast performance and very high contrast ratios. The QD-100MM measures a very lean 12.5 by 12.5 by 3 inches (HWD), weighs 5.9 pounds, and has a 10.4-inch active-matrix LCD that has a response time of 50 milliseconds and a contrast ratio of 60:1.

Even today's higher-end



SCREEN DREAM:

The QD-100MM is 3 inches thick.

monitors need additional video cards to give them true color capabilities. Also, most need some type of converter to allow them to accept video signals from sources other than PCs or Apples. These capabilities are built into the QD-100MM.

At 640-by-480 resolution, the QD-100MM is capable of true-color (16.7-million color) output. The display automatically detects and supports PC, Apple, NTSC, PAL, and SECAM video signals.

While the images produced by the QD-100MM are sharp and its colors brilliant, in no way is this \$7,995, 10.4-inch panel ready to replace the traditional monitor. It is, however, a fantastic solution for on-the-road presentations, video kiosks, and desktop video development production because of its tremendous built-in capabilities, light weight, and great portability.

The QD-100MM gives us a glimpse of the future, but until production yields of active-matrix displays increase, prices fall significantly, and screen sizes become at least 14 inches diagonally, good old monitors have nothing to worry about.

• List price: *Sharp QD-100MM*, \$7,995. Sharp Electronics Corp., Professional LCD Products, P.O. Box 650, Sharp Plaza, Mahwah, NJ 07430; 201-529-8731; fax, 201-529-9636.

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CD-ROM

Acculogic Pits HomePort Against Pricey Docking Stations

BY GREG PASTRICK

Chances are you'll rarely be compelled to pack a CD-ROM drive as a portable peripheral for your notebook. With the \$799, 6.25-pound Acculogic HomePort/CD you could, but the HomePort name reveals its true purpose as a workable alternative to deskbound docking stations.

Built to be stacked and chained with complementary hard disk and optical disk devices, the HomePort/CD is a SCSI-2-based device that connects directly to the standard parallel port on your notebook.

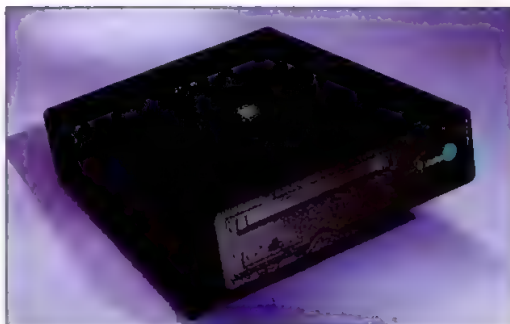
Since the practice of using notebooks both on-the-road

and as the primary CPU at an in-office workstation is well established, there's an obvious case to be made for the HomePort and its PC-to-CD parallel port connection. What you don't get are the multiple expansion slots and the speed of built-in drives that you'd find in a docking station.

Throughput speeds for the HomePort/CD are consistent with other CD drives that use the parallel port interface. In other words, it's slower than direct SCSI throughput. You benefit from the built-in SCSI-2 technology by chaining up to

seven devices together.

The 2.5- by 8.5- by 10-inch (HWD) CD unit features pass-through priority printing and holds an array of ports for input, output, printer, and PC connec-



PORTABLE CD: Plug in to a parallel port.

tions in back, plus two audio-out channels. On the front panel, the unit has a recessed power button, volume control for the headphone jack, and an eject button. The HomePort/CD uses a standard CD caddy, and although the covered, front-loading drive bay seals the disk effectively, it didn't always

instantly lock on and access it in our testing.

Audio through the headphone jack was adequate but far from optimal, too. We also experienced conflicts with some CD applications.

The HomePort/CD comes with a 3- by 5.75-inch external power supply, a 20-inch parallel cable, fast automatic setup software, and a CD demo disk. The whole package is a good alternative to higher-priced docking station CD setups, but you can't expect smooth full-

motion video and fast CD-based data access through a parallel port.

• List price: HomePort/CD, \$799. Requires: parallel port. Acculogic Inc., 13715 Alton Pkwy., Irvine, CA 92718; 800-234-7811, 714-454-2441; fax, 714-454-8527.

Circle 422 on reader service card

Data Compression

ARJ: A Worthy Competitor to PKZIP

BY BARRY SIMON

When PKZIP 2.0 was released last December, it was playing catch-up with its most serious data compression competitor: ARJ, from Robert Jung Software. Now Jung has responded with ARJ 2.41 (\$40 as shareware).

We tested ARJ 2.41a against PKZIP 2.04g on a 66-MHz 486-based system. Overall, PKZIP proved to be faster, but compression results with the two programs were about equal. Where ARJ comes out ahead is in its many options, all of which are controlled through arcane and archaic DOS command line switches.

ARJ's ability to compress data onto

multiple floppy disks is especially good. Any file that doesn't span floppies can be unarchived from a single floppy, which gives floppy disks some protection against developing errors. Since you can tell ARJ to read all the subdirectories on a given disk, compress files based on archive bits, and store full pathnames, ARJ can function as an efficient

floppy disk-based backup program if you write some batch files. And if you've found archiving to floppy disks to be slow, ARJ lets you prepare multivolume archives on a hard disk and copy them to floppy disks.

You can create several varieties of self-extracting archives, and BBS users will be interested in a separate program called

REARJ, which translates from a wide variety of archives (.LHA, .PAK, .ZIP) to .ARJ format.

ARJ can read filenames taken from within an archive, so you can use a supplied batch file that runs the DOS SORT command to rearchive a file sorted by filename, date, or archive bit.

For some, the fact that PKZIP is the de facto compression standard will discourage a switch to any other program, but others will be attracted by ARJ's flexibility, especially in

multiple-floppy-disk archives, and by Jung's aggressive site license policy.

• List price: ARJ, Version 2.41a, \$40 as shareware. Requires: 512K RAM, DOS 2.11 or later. ARJ Software, 2606 Village Rd., West Norwood, MA 02062; 617-769-5999; fax, 617-769-5999.

Circle 423 on reader service card

Performance Tests: ARJ, Version 2.41

In testing against PKZIP 2.04, ARJ 2.41 was slower across the board, but the two programs were equally effective at compressing files. The compressed file size is expressed here as a percentage of the uncompressed file size. A 1,000K file compressed to 40 percent would be a 400K compressed file.

	TEXT FILES		DATA FILES		GRAPHICS FILES	
	Compression Time (seconds)	Compressed File Size (percent)	Compression Time (seconds)	Compressed File Size (percent)	Compression Time (seconds)	Compressed File Size (percent)
	Time (seconds)	File Size (percent)	Time (seconds)	File Size (percent)	Time (seconds)	File Size (percent)
Lower scores represent better performance.						
ARJ 2.41	10	28.9	4	30.9	10	82.7
ARJ 2.41 (optimized for file size)	18	28.9	8	30.9	19	82.7
ARJ 2.41 (optimized for speed)	4	33.9	3	34.8	3	87.0
PKZIP 2.04	3	29.0	1	31.7	6	82.9
PKZIP 2.04 (optimized for file size)	6	28.7	2	31.7	9	82.7
PKZIP 2.04 (optimized for speed)	1	33.7	1	33.9	2	83.8

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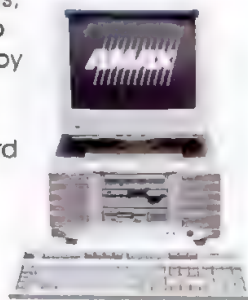
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The new 47,000 seat Great Southern Stand replaces the smaller original built in 1937. Finest Hour® helped schedule and coordinate the project's extensive concrete work.

U.S. Embassy, Bolivia

Primavera software is being used to control the construction of the new \$30 million U.S. Embassy in La Paz.

Remote Sensing Satellite, Canada

RADARSAT is a low orbit satellite that will take radar images of the earth. The engineering, design and manufacturing stages for this \$300 million project are being scheduled using Primavera Project Planner® (P3®).

The Autobahn, Germany

P3 will be used to rebuild the Autobahn in what was formerly

East Germany. Both contractors and subcontractors are standardizing on Primavera for this project.

New Hong Kong Airport, Hong Kong

This \$20 billion airport construction project also includes the construction of highways, an airport rail system, a suspension bridge and a cable stay bridge. Projected completion is June 1997.

Kuala Lumpur Tower, Malaysia

This \$100 million, 420-meter tower will be the third tallest communication tower in the world. Estimated completion date is 1996.

The Georgia Dome, USA

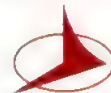
The new \$210 million structure features the world's largest cable-supported dome. P3 and Expedition® were used for scheduling and control.

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CIRCLE 148 ON READER SERVICE CARD

New & Improved

NEWS OF ANNOUNCED PRODUCTS AND UPGRADES

By Brad Grimes

IMPROVED

NEC's VersaPad Comes with Handwriting Recognition Engine

NEC Technologies' UltraLite Auto-graph pen computer is now known as the VersaPad, and it's been enhanced with an Intel 20-MHz 3.3-volt 486SL processor, 4MB of RAM, and an 80MB hard disk, plus a 9.4-inch display, local-bus graphics, and two PCMCIA Type II slots. The VersaPad comes with Communication Intelligence Corp.'s Handwriter Recognition System, which works with CIC's PenDOS and Microsoft's Windows for Pen Computing. All four major pen-based operating systems—PenDOS, Windows for Pen Computing, PenPoint, and PenRight!—are supported, and the VersaPad has a dual-boot option for loading Windows for Pen Computing and PenPoint on the same system.

- List price: *NEC VersaPad*, \$2,999. *NEC Technologies Inc.*, 1414 Massachusetts Ave., Boxborough, MA 01719-2298; 800-388-8888, 508-264-8000; fax, 800-327-8329.

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IMPROVED

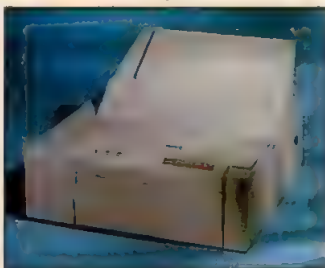
Adaptec Makes It EZ to Configure SCSI Devices

Adaptec is making it easier to install and configure its SCSI adapters for use with devices such as Photo CD-ROM drives. Adaptec EZ-SCSI, Version 2.0, is a DOS and Windows-based SCSI software package that configures your peripherals with minimal effort. For the most part, all you do is run the software and select the default settings. Now EZ-SCSI supports Photo CD, and it includes a Photo CD Viewer so you can see, size, and crop photographic images stored on CD-ROM. The software also includes a CD Play application that provides an on-screen control panel for playing audio CD-ROMs. Registered users of various Adaptec SCSI software programs can upgrade to EZ-SCSI 2.0 for \$29.

- List price: *Adaptec EZ-SCSI, Version 2.0*, \$75 (\$29 to upgrade). *Adaptec Inc.*, 691 S. Milpitas Blvd., Milpitas, CA 95035; 800-442-7274, 408-945-8600; fax, 408-262-2533.

Circle 403 on reader service card

HOT PROSPECT



NEC Introduces New Class of Host-Based Windows Printers

On the surface, **NEC Technologies'** new Silentwriter SuperScript 610 laser printer is the next in a long line of successful Silentwriter printers. But it's what goes on inside your PC that makes this first entry in a new line of NEC laser printers faster and easier to use. The Silentwriter SuperScript 610 uses Windows software to prepare documents in conjunction with the host PC's CPU. Data doesn't need to be interpreted by the printer, processed, and then printed out, and every time you upgrade your PC's processor, you improve the performance of your printer.

The printer itself is rated at 6 pages per minute and features 300-dot-per-inch resolution with Sharp Edge Technology that can push that figure to 600-dpi. It supports HP LaserJet IIP emulation for the times when you're not printing under Windows, as well as PostScript Level 1 and Windows GDI. It has a high-speed bidirectional parallel interface, which gives you on-screen real-time status reports on your print jobs. In compliance with the EPA's EnergyStar guidelines, the printer powers down to less than 20 watts after 15 idle minutes.

- List price: *NEC Silentwriter SuperScript 610*, estimated street price: \$650. *NEC Technologies Inc.*, 1414 Massachusetts Ave., Boxborough, MA 01719-2298; 800-388-8888, 508-264-8000, fax, 800-327-8329.

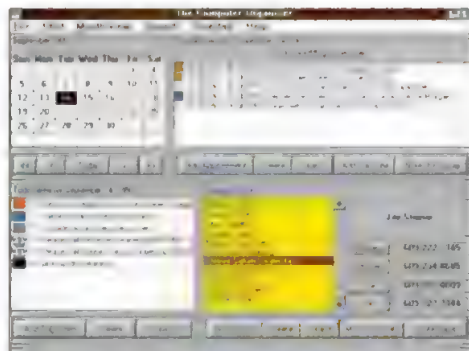
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NEW

Impulse Ships Easy-to-Use PIM for Under \$30

It's great to see more shareware products making their way into the retail channel. **Impulse Software** has taken the shareware personal information manager Time and Chaos, from iSBiSTER International, and turned it into The Computer Organizer for Windows, a quick, easy-to-use PIM that costs under \$30. All your important information—address book, calendar, to-do list, and appointment list—is on one screen, and everything can be searched by text strings. For a Windows product, The Computer Organizer is very quick, spending little time accessing your hard disk.

The Computer Organizer is not feature-laden, but it does provide three views of your calendar; two address books (white and yellow pages) that can handle an unlimited number of contacts; report generation at the touch of a button; links between all your lists and your address books; and the ability to print calendars, envelopes, and pages for popular daily



Quick and dirty: The Computer Organizer makes all your information easily accessible on one screen.

planners. It has an auto-dialer, reminder alarms, and a Time Bar view of your appointments. The program warns you of scheduling conflicts and lets you prioritize your to-do items. For quick letter generation from the address book, The Computer Organizer links to your Windows word processor.

- List price: *The Computer Organizer for Windows*, \$29.95. *Impulse Software Inc.*, 418 W. Arapaho Rd., Richardson, TX 75080; 214-437-2849; fax, 214-437-6220.

Circle 404 on reader service card

New & Improved

NEW

Traveling Software Pulls All Your Comm Chores Together

The maker of LapLink V, **Traveling Software**, is putting all the necessary communications tools into one package and calling it CommWorks for Windows. In addition to LapLink V file-transfer software, the product comes with LapLink Remote Access for dialing into remote PCs and networks and for working with files or other resources, such as printers. LapLink Alert lets you know the instant a file, message, or fax arrives at your PC by popping up a notice or playing a Windows .WAV file. The program's TS FAX module has all the features of a desktop faxing program, along with a series of status lights that emulate the lights on an external modem. TS OnLine gives you point-and-click access to major on-line services like CompuServe and MCI Mail through a basic communications interface.

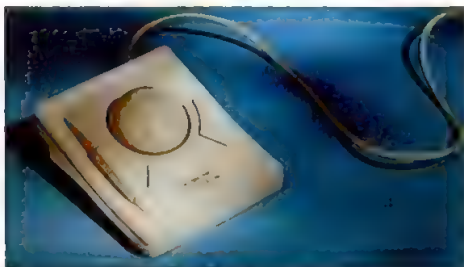
All five of the CommWorks modules appear on the CommWorks Control Center button bar. If you have a program that you prefer to the ones that Traveling Software provides, you can place it on the Control Center bar and use it in lieu of the CommWorks module.

• List price: *CommWorks for Windows*, \$199. *Traveling Software Inc.*, 18702 North Creek Parkway, Bothell, WA 98011; 800-343-8080, 206-483-8088; fax, 206-487-1284. Circle 405 on reader service card

IMPROVED

The Next Generation Expert Mouse Is Faster than Before

Kensington Microware Ltd.'s highly-acclaimed Expert Mouse trackball is now in version 4.0 with significant enhancements to both the hardware and the software. The trackball itself is larger than other trackballs, offering greater speed and accuracy. Most of the old hardware controls have been replaced with software. Using the Expert Mouse's Brilliant Cursor technology, you can program your cur-



Get a hand on the new Expert Mouse 4.0.

BRIEFS

BERNOULLI AND MAGNETO-OPTICAL DRIVES

Iomega Corp. is shipping an enhanced version of its Bernoulli MultiDisk 150 drive with a 256K write cache that speeds access to the Bernoulli cartridge by up to three times. The new drives have an 18-ms effective access time and a 5-megabyte-per-second (MBps) burst transfer rate. External drives plus adapters cost \$1,222; internal drives cost \$1,099. A Transportable MultiDisk 150 goes for \$1,225, while a Dual MultiDisk is \$2,499. 150MB Bernoulli cartridges cost \$225. 800-777-6179, 801-778-1000

Alphatronix has announced the Inspire III family of rewritable optical drives (starting at \$4,495) that support 1.3GB optical disks. The Impulse III GG series drives have an average seek time of 19 ms, a burst transfer rate of 5 MBps, and a maximum sustained throughput of 2.2 MBps. They come in 12-pound minibox and 38-pound desktop models. 800-849-5807, 919-544-0001.

Maxoptix is offering the industry's first 5.25-inch, 1.3GB rewritable optical drive, the T3-1300 (\$3,495). It has a 19-ms average seek time, a burst transfer rate of 5 MBps, and a maximum sustained throughput of 2.2 MBps. A 4MB read/write cache is user-programmable. The T3-1300 supports full media read/write interchange with earlier 650MB and 1GB media, and works with all major jukeboxes. The price of a 5.25-inch, 1.3GB optical disk is \$249. 800-848-3092, 408-954-9700.

On the lower end of the optical drive scale, **LaserByte Corp.** has introduced the LB3128 (\$800), a 3.5-inch, 128MB rewritable optical disk drive with a 256K cache buffer. The LB3128 has an average seek time of about 28 ms, a burst transfer rate of 4 MBps, and a sustained transfer rate of 768 kilobytes per second (KBps). It supports partial read-only memory (P-ROM) as well as optical read-only memory and rewritable media. Mass production is expected to begin in the fourth quarter of this year. 408-734-9200.

sor to jump to any predefined spot on the screen, and in addition to the ten standard acceleration options that come with the Expert Mouse software, you can customize your own acceleration speed. The software also lets you temporarily slow down cursor movement for precision control, and lets you create and save up to 23 combinations of Expert Mouse commands per application.

• List price: *Expert Mouse, Version 4.0*, \$149.95. *Kensington Microware Ltd.*, 2855 Campus Dr., San Mateo, CA 94403; 800-535-4242, 415-572-2700; fax, 415-572-9675.

Circle 406 on reader service card

IMPROVED

MailRoom Makes It Easy to Use MCIMail Under Windows

Windows front ends for MCI Mail have tended to get mixed reviews, but **Sierra Solutions'** MailRoom is quietly making a name for itself among a group of users that appreciate its no-nonsense handling of MCIMail. Now in version 1.1, this low-cost solution supports modem speeds of up to 19,200 bits per second, as well as all of MCI Mail's message-handling features. MailRoom has an address book that handles EMS, MCI, fax, telex, and paper addresses, and it can be automatically updated with the addresses from incoming messages with a click of the mouse.

When MailRoom is operating, a handy icon appears on-screen that tells you the status of your session. Although you can't program MailRoom to poll MCI Mail at regular intervals, you can set it up to poll at four designated times during the day. If you have questions about MailRoom, you select To Customer Service from a pull-down menu and a message is addressed to the folks at Sierra Solutions.

• List price: *MailRoom, Version 1.1*, \$85. *Sierra Solutions*, 2016 Kelton Ave., Los Angeles, CA 90025; 310-478-2531; MCI ID, 545-0183.

Circle 407 on reader service card

NEW

Caere Ships Hand-Held Scanner With All the Trimmings

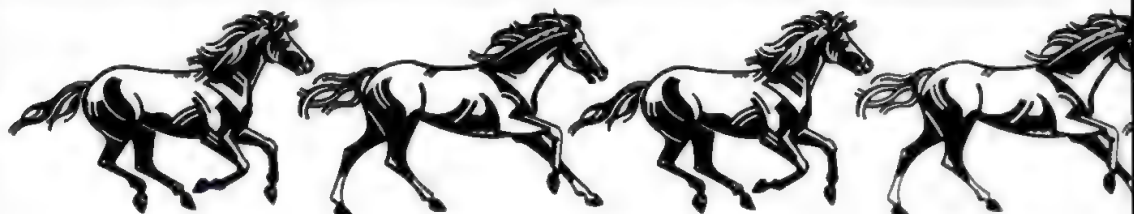
As far as complete solutions go, **Caere Corp.**'s OmniScan hand-held scanning solution represents a logical bundle at an attractive price. The key to the OmniScan hand-held scanner is that all the software you need for productivity comes from Caere itself, a recognized leader in scanning and optical character recognition (OCR) software. The vendor's new

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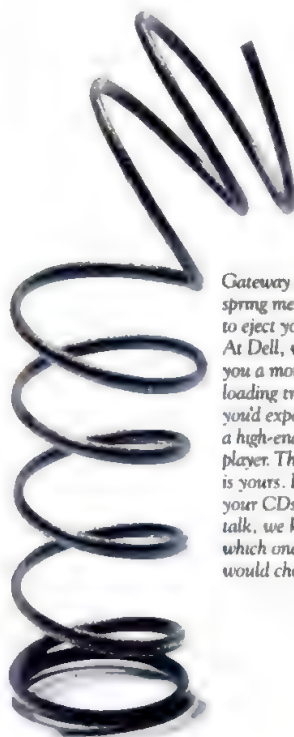


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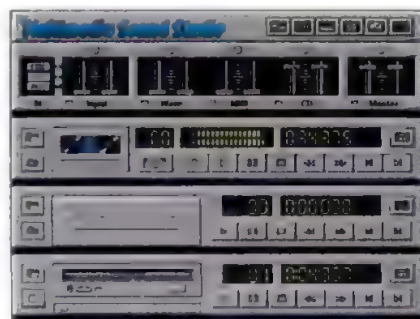
With faster access and nearly double the data transfer rate, our double-spin CD ROM makes Gateway seem positively sluggish.



Thanks to our multi-session CD technology, you can have the disk printed on up to four different times, storing up to 100 color photographs in all.

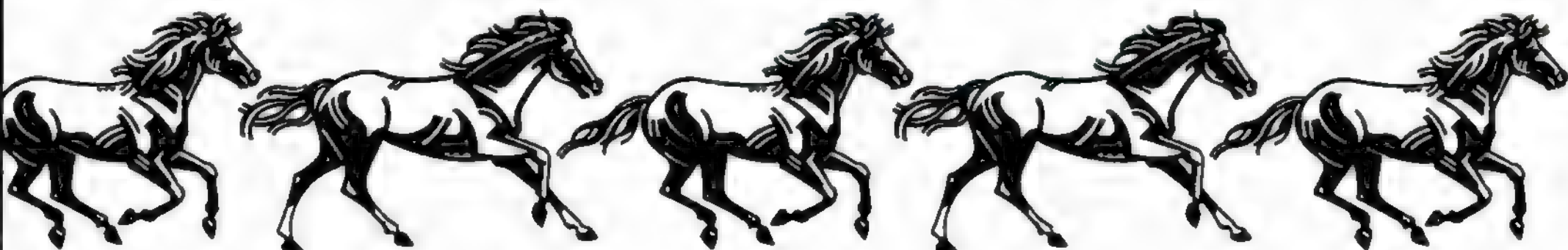


Gateway uses a spring mechanism to eject your disks. At Dell, we give you a motorized loading tray like you'd expect from a high-end CD player. The choice is yours. But if your CDs could talk, we know which one they would choose.



Whistle while you work. Or tap your foot. Or sing along. Our audio center CD ROM software lets you play disc jockey while you carry on with the important work of the day.

CDs FAST CDs.



153.6KB

300KB

When you buy a Dell Dimension™ XPS 450V or 466V equipped with a CD ROM, you get a CD ROM drive that runs circles around Gateway's*.

Our CD ROM drive gives you nearly twice the performance of Gateway's thanks to advanced double-spin technology that doubles the transfer rate and helps to speed up access time. In short, it's faster.

And that's just the start.

Our drive has the automatic, push-button motorized tray you'd expect to find on a high-end CD player. So your CDs glide in and out effortlessly.

Gateway's has a manual spring-load reject, uh, eject button. It's still push-button, but your CDs don't glide effortlessly. In fact, they don't glide at all.

Ours is obviously a lot easier and more pleasant to use. And our CD ROM drive is built to last.

Our CD ROM is Kodak Photo-CD compatible. Which means you can take advantage of the latest in CD technology and view photographs on your PC screen.

What's more, our CD drive is multi-session. Which means you can have the disk printed on up to four different times. Storing up to 100 pictures in all.

Our CD ROM also comes with software that lets you play your favorite tracks from any audio CD.

So you can listen to Mozart as you crunch numbers or bop along to the Beatles as you cruise your local BBS.

So if you want the best CD ROM technology for your money, make a fast decision and call Dell today.

After all, there's absolutely no reason why you should settle for a CD ROM that's behind the times.

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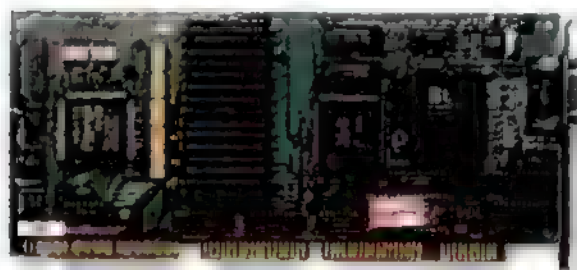
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*Promotional price expires 9/30/93. *Performance measured by running WinBench version 3.11 at 1024 x 768, 256 colors, using Viper Video Driver ver. 1.1. **Dell assumes no responsibility for face-warping acceleration injuries. *Prices valid in the U.S. only. Some products and promotions not available in Canada. MS-DOS is a registered trademark and Windows is a trademark of Microsoft Corporation. The Intel Inside logo is a registered trademark and 486 is a trademark of Intel Corporation. Business leasing arranged by Leasing Group, Inc. Dell disclaims proprietary interest in the marks and names of others. ©1993 Dell Computer Corporation. All rights reserved.

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RAM (the fastest PC graphics accelerator board on planet Earth), this speed demon is the perfect solution for color publishing, multimedia and high-end graphics applications.

Thanks to the Viper, the 466V Ultimate features a virtually flicker-free display at all resolutions, a palette of up to 16 million colors, and turbo drivers to drive all Windows™ 3.1 applications even faster. Before we forget, the Viper has 2MB of VRAM for the face-warping acceleration** that leaves others way behind.

The 466V Ultimate comes fully decked out. With 16MB of RAM upgradeable to 64MB. A 450MB local bus IDE hard drive. High-speed 256KB static RAM external cache. Five available 16-bit expansion slots — one of which can support an additional high-speed VL device. A 15-inch UltraScan™ 15FS non-interlaced monitor with 1024 x 768 pixel display. One internal diskette drive. Our double-spin CD ROM drive. Configured with MS-DOS® 6.0, Windows 3.1 and of course, a mouse.

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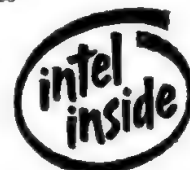
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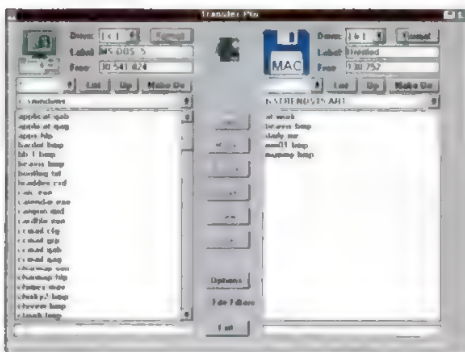
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• List price: *OmniScan*, \$449. *Caere Corp.*, 100 Cooper Ct., Los Gatos, CA 95030; 800-535-7226, 408-395-7000; fax, 408-354-2743.
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NEW

PC or Mac: It's All the Same to TransferPro for Windows

In many offices, PCs and Macintosh computers live side by side, presenting the problem of how to share data between platforms. **Digital Instrumentation Technology (DIT)** has announced *TransferPro for Windows*, which lets you format, read, and write 720K and 1.44MB DOS-compatible disks as well as 1.44MB Macintosh disks. *TransferPro* also supports external SCSI media like Bernoulli and SyQuest drives, plus several magneto-optical drives. Because of internal hardware limitations, 800K Macintosh disks are not supported;



TransferPro for Windows displays files on DOS and Mac disks and lets you work with both.

there are external drives that read 800K.

The Windows graphical interface displays two file system browsers with icons that tell what type of media you're looking at. From this screen you can copy, delete, move, rename, or transfer files or directories between like and unlike media.

• List price: *TransferPro for Windows*, \$99 (\$89 through September). *Digital Instrumentation Technology Inc.*, 127 Eastgate Dr., #20500, Los Alamos, NM 87544; 800-467-1459, 505-662-1459; fax, 505-662-0897.
Circle 409 on reader service card

BRIEFS

BERNOULLI AND MAGNETO-OPTICAL DRIVES

The new Memory Division of **Olympus Image Systems** has put out its first 3.5-inch, 128MB optical drives, the MOS 300E standalone drive (\$1,250) and the MOS 300S subsystem drive (\$1,500). The average seek time on these drives is about 38 ms, the average access time is 46 ms, and the sustained transfer rate is 768 KBps. Each comes with a 256K cache buffer. 800-347-4027, 714-453-4469

SOFTWARE

Integritech Software is shipping *Aware!* (\$99 single user, \$399 network version), a Windows-based problem-management program that lets customer service personnel record and track customer problems. *Aware!* imports data from a variety of contact managers and accounting programs. It runs on Banyan's VINES, NetWare, LANtastic, and 3Com network software. 800-942-6499, 817-267-3163.

Keyfile Corp. has unveiled a Windows application called *Doceo* (\$149) that lets you link or embed electronic files and scanned documents or images into a single multipage integrated document. These documents can then be included in a mail message or a database application using OLE. *Doceo* also supports DDE 603-883-3800.

VAX system software developer **Executive Software** enters the PC market with *File Alert for Windows NT* (\$99 for a limited time), a 32-bit application that automatically detects file corruption beyond the functionality of antivirus utilities. *File Alert* continually checks and verifies data integrity in all file types from all possible sources. It creates and maintains a log of corrupted and deleted files. 800-829-4357, 818-547-2050

Version 1.6 of **AddressMate Software's** DOS-based automatic envelope-addressing and bar-coding product, *AddressMate* (\$49.95), now prints US Postal Service 11-digit Delivery Point Bar Codes (DPBCs). The memory-resident program also features bar code

NEW

Alacritry Puts All Your Office Equipment at Your Fingertips

Alacritry Systems has taken its E-Quip network imaging system and brought it to the standalone PC in the form of the E-Quip Private Station. If you have a printer, a desktop scanner, and a fax modem, E-Quip's nine Windows modules can manage all your office equipment. The Copier module looks like a copier control panel, and it turns your scanner and printer into a real personal copier that auto-feeds originals, reduces or enlarges documents from 50 to 150 percent original size, and electronically collates the output. Three other modules—Scan to File, Viewer, and Finder—combine to create an electronic file cabinet for managing documents and images.

Alacritry also offers *Office-in-a-Box* for \$1,195 (\$795 through October), which includes E-Quip software plus a four-page-per-minute scanner and a 9,600-bps fax modem.

• List price: *E-Quip Private Station*, \$495 (\$399 through October). *Alacritry Systems Inc.*, 43 Newburg Rd., Hackettstown, NJ 07840; 800-252-2748, 908-813-2400; fax, 908-813-2490.

Circle 410 on reader service card

IMPROVED

JetForm Routes Forms Across DOS, OS/2, Windows...and Mac

JetForm Corp. offers a line of products that manage workflow across networks, from client processing to forms routing, tracking, and management. Version 3.1 of *JetForm for E-Mail* works across Macintosh platforms in addition to DOS, OS/2, and Windows. Now you can fill in forms and mail them to colleagues who are using Macs. The new *JetForm Filler* products (\$495 for 5 workstations) work in conjunction with *JetForm for E-Mail* and provide support for e-mail programs like cc:Mail and Microsoft Mail. Other new features of *JetForm for E-Mail 3.1* include circulation lists for forms that don't always take one specific route; form-tracking messages, which alert the originator of a form when it is passed on to a different person; and a return-to-sender option, which lets you return a form to anyone who has preceded you on the route.

• List Price: *JetForm for E-Mail, Version 3.1*, \$495 for 5 workstations. *JetForm Corp.*, Watermill Center, 800 South St., #305, Waltham, MA 02154; 800-538-3676, 617-647-7700; fax, 617-647-4121.

Circle 411 on reader service card

New & Improved

NEW

Plustek Ships New Scanners

Plustek USA, the pioneer of color, sheet-fed scanners, has a couple of new offerings: the ScanPlus ADF 600 C and the gray-scale ScanPlus ADF 600 G. Both are sheet-fed desktop scanners with 50-page automatic document feeders. The ADF 600 C uses single-pass scanning in color mode to scan at a resolution of 600-dpi, and it supports 256 to 16.8 million colors.

The ADF 600 G is a low-cost, entry-level desktop scanner with a two-year unconditional warranty. Its features are similar to Plustek's original ScanPlus 600, but the 600-dpi ADF 600



The ScanPlus ADF 600 G.

G also has powerless operation, meaning you don't plug it into the wall because it uses the PC as its power source.

- List price: ScanPlus ADF 600 C, \$1,299; ScanPlus ADF 600 G, \$899. Plustek USA Inc., 3350 Scott Blvd., Building 46, Santa Clara, CA 95054; 800-685-8088, 408-980-1234; fax, 408-980-5184.

Circle 420 on reader service card

NEW

Take Pinnacle Micro's New Magneto-Optical Drive with You

The goal for **Pinnacle Micro's** new 128MB Pinnacle Tahoe 130 magneto-optical drive is to give you more storage on demand when you're away from the office. The portable, 3.5-inch drive weighs just 1.8 pounds and measures 1.4 by 4.5 by 8 inches (HWD). It has a rechargeable battery pack option for \$199 that provides 3.5 hours of use, effectively extending the battery life of your portable PC by cutting down the times you access your PC's floppy and hard disk drives. The Tahoe 130 is a fully rewritable optical drive with a 28-ms seek time, supporting both SCSI and parallel interfaces. Each 128MB disk is ISO/ANSI-compliant so you can swap disks between drives.

BRIEFS SOFTWARE

printing for five-digit ZIP codes, access to multiple database files, better network compatibility, support for an unlimited number of return addresses, and improved address recognition. Registered users can upgrade for \$19.95. 510-237-7460

Smith Micro Software Inc. (SMSI) has released HotFax, Version 2.0 for DOS (\$149.95), with OCR built in as well as its popular ModemMonitor feature which provides modem status lights on-screen. Also included is FaxHost, which lets you dial into your PC, see what faxes you've received, and then send faxes to other recipients or forward them to yourself. 800-964-7674, 714-362-5800.

No financial program should make decisions for you, but **Ones & Zeros Software** expects its Per%Sense line of programs will give you plenty of information to help you out. The basic Per%Sense package (\$49.95) offers mortgage calculations and comparisons, loan amortizations, and basic financial planning. Per%Sense 2 (\$99.95) is more advanced with variable rate loan calculations and more, while Per%Sense PRO (\$350) also provides a full range of actuarial calculations. 800-882-2764, 415-587-1010.

With the release of Lotus 1-2-3, Release 4.0 for Windows, leading add-on publisher **Intex Solutions** has announced that several of its most popular enhancement products have been updated to work with the new Lotus 1-2-3 release. Among them are: Clip Artist (\$159.95), CompressMate (\$99), Forecast! (\$165), Forms-To-Go! (\$129.95), Ready to Run Accounting (\$199.95), Tax Solver (\$79.95), TRANS (\$125), and Verbose (\$95). 617-449-6222.

Decisioneering is shipping Crystal Ball for 1-2-3 Release 4.0 for Windows (\$295), an add-in package that performs general purpose forecasting and risk analysis. Crystal Ball's Trend Charting feature lets you view forecasts and risks graphically over time. 800-289-2550, 303-292-2291.

- List price: Pinnacle Tahoe 130, \$1,199. Pinnacle Micro Inc., 19 Technology, Irvine, CA 92718; 800-553-7070, 714-727-3300; fax, 714-727-1913.

Circle 412 on reader service card

IMPROVED

New Proxima Projection Panels Deliver Over Two Million Colors

The newest Ovation active-matrix LCD projection panels from **Proxima Corp.** are capable of projecting over 2 million colors, and they achieve better image quality thanks to Proxima's new Active Color Enhancement (ACE) technology. The new Proxima Ovations come in 8.4-inch and 10.4-inch models with support for VESA standards and all three worldwide broadcast video standards (NTSC, PAL, and SECAM).

The Ovation panels also come with a set of interactive tools for controlling your presentations, including the Cyclops, which works like a cordless mouse so you can control software applications from up to 25 feet away. Proxima's Remote Presentation Control software lets you move forward and back, pause your presentations, and program your own macros.

- List price: Proxima Ovation, Version 4.0, \$4,995 to \$6,995. Proxima Corp., 6610 Nancy Ridge Dr., San Diego, CA 92121-3297; 800-447-7694, 619-457-5500; fax, 619-457-9647.

Circle 413 on reader service card

NEW

R&R Report Writer Adds SQL For Client/Server Reporting

Concentric Data Systems is shipping R&R Report Writer SQL Edition, giving users of Btrieve, Microsoft SQL Server, NetWare SQL, Oracle, Sybase SQL Server, and Xbase a Windows-based client/server data access and reporting tool. The SQL Edition is also a developer's tool with an unlimited-distribution, royalty-free runtime version. Novice end users can automatically generate SQL statements and convert calculations, sorts, and filters into SQL expressions. The graphical user interface makes it easy to use the SQL Edition to enhance report layouts and import images in 12 formats including .BMP, .PCX, and .TIFF.

- List price: R&R Report Writer SQL Edition, Version 2.0, \$395 (\$149 to upgrade). Concentric Data Systems Inc., 110 Turnpike Rd., Westborough, MA 01581; 800-325-9035, 508-366-1122; fax, 508-366-2954.

Circle 415 on reader service card

COREL DRAW!

The Best in Graphics

...and more!



Get animated with CorelDRAW 4!

CorelDRAW is renowned for its powerful graphics capabilities. CorelDRAW 4 now leaps even further ahead by adding page layouts, animation and OCR, as well as hundreds of other feature enhancements. It's the best value in software today—and it's still the easiest to use!

CorelDRAW 4 is the ideal desktop publishing tool! It includes illustration, charting, photo-editing, tracing/OCR and presentation capabilities...and so much more! There are advanced word processing features, multi-page layouts and dozens of artistic and special effects. It's packed with more fonts, more clipart images and symbols, more graphic tools and business applications. And now CorelDRAW 4 also includes CorelMOVE, a brand new animation module.

ALSO INCLUDES TWO BONUS CD-ROMs

—featuring a complete CD version of CorelDRAW 4 plus libraries of clipart images and symbols, fonts, animation and sound, and a Video for Windows enhanced QuickTour.



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PRESENTATIONS
FILE MANAGEMENT
ANIMATION**

- Comprehensive DTP Features
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Read Only

REVIEWS OF THE LATEST BOOKS FOR THE PC USER

Edited by Carol Levin

The Essential Guide To PC Hardware

BY NICK STAM

For the best single source of information on PC hardware, you need the updated edition of the *Winn Rosch Hardware Bible*. Unquestionably the most comprehensive and well-written hardware book for computer users, the original *Hardware Bible* described all aspects of PC hardware in understandable terms and was organized for quick referencing. Author Winn L. Rosch repeats the success in the much-expanded second edition.

Spanning over 1,100 pages, the book's many new sections reflect advances in industry standards since 1988 and provide enough technical detail to prepare you to converse with vendor technicians, salespeople, and system designers.

Rosch revisits the birth of the PC in 1981 and goes on to discuss motherboard, memory, and microprocessor technologies. Coverage of the Pentium, however, is incomplete. Conventional, expanded, and extended memories are examined in detail, as are shadow memory, high memory area, VCPI, and DPML. You'll find the chart of DRAM and SIMM components useful for system upgrades. He then lays out the details of expansion bus architectures (ISA, MCA, and EISA) and local-bus standards (VESA's VL-Bus and Intel's PCI), bus-mastering, burst and streaming transfer modes, arbitration, and interrupt handling.

The instructive chapter on BIOS compatibility includes

tables of BIOS interrupts and data areas. The author also covers support chips—timers, interrupt controllers, real-time clocks, and DMA controllers.



Especially knowledgeable in power supplies, UPSs, and laptop batteries, Rosch highlights the key issues every computer user should know. There are 150 pages on video adapters and monitors, including excellent insights on monitor safety and radiation, as well as tips on

shopping for a monitor. The book is also an excellent hard disk reference, and the entire modem section is a must-read.

The *Hardware Bible* is highly recommended to anyone who wants to understand how his or her computer works.

• **Winn Rosch Hardware Bible**, by Winn L. Rosch, \$34.95.

Brady Publishing; 800-428-5331. ISBN: 0-13-932260-4.

Circle 477 on reader service card

Inside Computer Crime

BY ANGELA GUNN

The electronic frontier is disappearing at the speed of a fast modem link. While most computer users live in the relative safety of LAN settlements and standalone PC enclaves, computer criminals and vigilantes still roam the terrain.

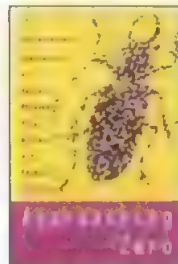
Approaching Zero will doubtlessly be compared with *The Hacker Crackdown*, another excellent book about the underside of cyberspace. Cowritten by an American journalist and a British computer expert, the book documents myriad serious crimes—

security breaches, credit card fraud, illegal tampering, robbery, and espionage.

The book focuses on international computer crime, first illustrating the ease with which basic larceny can be committed and then documenting the effects that such a crime can create. It reports cases in which hacking and rogue programming turned ugly and even describes a case of international spying that ended with a suspicious death. Chillingly, much of the crime discussed was facili-

tated by overenthusiastic computer users who used their knowledge either thoughtlessly or callously, or by MIS managers who allowed a motley group of users to gain access to machines in their workplaces.

It's a great read, but the incidents described point to a frightening conclusion: Phone freaks, hackers, and virus writers shape our world, even if they don't yet own it. A virus written to extort money from users of a shareware program



wiped out ten years of AIDS research data in Italy. And the credit ratings and credit card numbers of any citizen are available to computer users not yet old enough to drive.

The authors have done a masterful job of pulling their sprawling tale into a coherent whole. *Approaching Zero* leaves an ominous quiet, where you know something's going on but not what it is. The book offers few solutions and less hope, but its message may make you reconsider your own vulnerability on the wide frontier.

• **Approaching Zero**, by Paul Mungo and Bryan Clough, \$22. Random House; 800-733-3000. ISBN: 679-40938-6.

Circle 478 on reader service card

When Trouble Logs On

Where there is lawlessness, there is law. Right? Well, maybe not on the electronic frontier, where privacy, liability, and First Amendment issues have not yet swamped the courts. The body of legal opinion isn't weighty, but laws governing the on-line world are coalescing rapidly.

Syslaw is an excellent guide to on-line privacy, pornography, credit card fraud, search-and-seizure, and copyright law (\$34.95, PC Information Group; 800-321-8285). Attorneys Lance Rose and Jonathan Wallace take the position that BBSs are entitled to full protection under the First Amendment. Admittedly, it's no substitute for a living, breathing lawyer, but *Syslaw* is an excellent guide to legal aspects of BBS administration.—Angela Gunn

A buyer's guide featuring Tips & Tricks

for some of your favorite applications

The Hayes ACCURA



A PC without a communications

link is like one hand clapping; if you are unable to connect to the world of on-line databases, networks and Fax machines you might as well work in a closet. With this vast on-line world, however, many people aren't sure where to start. And once they start they end up making several purchases before finding the right combination.

Hayes, which has long set the standards

Hayes Accura 144 + FAX144 Modem

Full Communications Solution
INTERNAL
List Price: \$269

DUSTIN PRICE: \$225

EXTERNAL
List Price: \$299

DUSTIN PRICE: \$249

Requires: (Accura) Open serial port.
(Smartcom) Windows 3.0 or higher;
DOS 3.1 or higher; 2 MB RAM;
5 MB hard disk space; Modem.

for modems, now supplies a one-stop, economical answer to all of your PC communications needs. The Hayes ACCURA 144+Fax144 modem provides, in a single box, all of the hardware, software and cabling needed to go on-line. Communications protocols and speeds change quickly, with something faster and better always just around the corner. ACCURA customers, however, need not worry about such details. This modem handles up to 14,400 bps using CCITT V.32bis, which set the standards for high-speed communication. It can also operate as slowly as 300 bps, which means that it can connect to practically any modem on the planet.



Hayes Smartcom for Windows

While a "light" version of Smartcom for Windows is included with the Accura modem, many will want the full package. Smartcom for Windows has three founding principles: simplicity, automation and performance. This makes Smartcom a great choice for anyone who wants to tie a PC to the outside world. While experienced communicators will be surprised at how little is needed to perform advanced functions, novice users will be able to make their first connection just by entering a phone number and clicking an icon. Smartcom is both fast and efficient and, in addition to supporting all popular terminal emulations and file transfer protocols, Smartcom also includes the ESI driver for the Hayes ESP communications accelerator. This allows you to incorporate the most sophisticated high-speed and data loss prevention abilities on the market today. So when you make a connection with Smartcom, you will only need to make it once.

Hayes Smartcom for Windows

Full Communications Solution
SMARTCOM
List Price: \$49

DUSTIN PRICE: \$49

TIP While your ACCURA modem is capable of traveling at the fastest speeds, you may need to slow down to accommodate the folks on the other end. Poor line quality may force you to decrease the speed accordingly. Nevertheless, the ACCURA will allow you the maximum speed for existing conditions. It is equipped with the latest error correction technology, automatically adapting to the signal.

It is equipped with the latest error correction technology, automatically adapting to the signal.

TIP SMARTCOM for Windows supports five major languages: English, German, French, Italian and Spanish. You can change the default language at any time. In order to facilitate international communication, you can purchase a Smartcom for Windows package and ship it to an overseas colleague.

Communication has become one of the most important software categories. Without an effective communication structure your PC is like one hand clapping. Dustin Discount Software makes it easy for customers to communicate their order on a toll-free line or use the convenient 24-hour FAX line (818-884-5310) to place your order 'round the clock.



TIPS, TRICKS & SHORTCUTS

PackRat 5.0: Staying on Track



PackRat 5.0

Personal Information Manager

Last Price: \$395

**DUSTIN
PRICE: \$259**

Requires: Windows 3.0 or higher,
DOS 3.0 or higher; 80386/20 or greater;
1 MB RAM; 8 MB hard disk space; VGA or
higher; Mouse; Modem (for autodial).

grating environment for the management of contacts, schedules, tasks, projects and documents.

So if you think that a powerful PIM will be too hard to use, then you haven't seen the PackRat 5.0 upgrade.

A good PIM needs to have enough structure to keep you on track while allowing enough

PackRat 5.0 offers a giant leap forward for the Personal Information Manager (PIM). It includes and improves upon the powerful features that have been part of the program in the past (PackRat has been around since Windows 1.1). Additionally, this new version streamlines the interface and places these advanced information management functions in easy reach of every user. It is a complete and powerful inte-

flexibility with regard to personal preference. PackRat provides this, adding elements of project management, financial management and document manipulation to the traditional phone book and scheduling mix (which PackRat has also improved). Every piece of data fits into a form or a category, for easy organization and retrieval. The result makes PackRat a full-blown application, where other underpowered PIMS only qualify as a utility.

The new PackRat interface employs a file folder metaphor that allows you to toggle between different information through folder-like tabs. With this familiar metaphor, you can use PackRat's pre-configured folders, or define those that support the way you work. Once you establish your categories, the tabs allow you to switch easily between them. For instance, you might be assembling a task list or checking an appointment when you need to place a call. Going from one to the other takes but a single click.

PackRat is flexible. You may want to use it for easy access to completed projects and documents. Or you may create a folder for a specific project and delete the folder when the project is completed. Using PackRat, you start a new folder at the beginning of each major project, easily including and incorporating all of the tools and the applications needed to get the job done.

PackRat 5.0 brings PIM power to the people, allowing you to organize the large and small issues that make up your business day. Whether it is a file, application, project or object, it will fit easily into PackRat's visual structure. And once you upgrade to a functional PackRat environment, your level of efficiency and organization can only increase.



Plain Wrap Prices,
Black Tie Service.

TIPS ① PackRat's SmartStart facility can help you to determine a "starting lineup" of folders, depending on your occupation. Once you create this initial setup, you can modify it to exactly fit your workstyle by adding objects and/or folders.

② You can turn any DOS or Windows program or file into a PackRat object with a simple drag and drop action. After this, the file or application appears in the folder, and is accessible with a double mouse click.

③ Each PackRat object is customizable with an "Instant Options" menu. You just right-click on the object to call up a dialog box which allows you to modify fonts, filters and any other appropriate properties.

④ You can eliminate repetitive actions by editing PackRat's forms to contain a combo box. Here, the text box is attached to a list of possible choices for that field and you can select the correct option without typing.

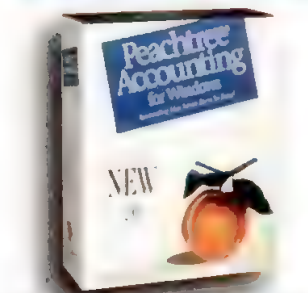
⑤ It's a snap to merge data from a handheld computer. With the Prompt command, PackRat detects duplicate records and asks you to select the most current version.

⑥ The PackRat mousepad, included in every package, places all of the program's most important commands literally at your fingertips. It offers step-by-step instructions for the most common PackRat procedures, along with a visual roadmap of the entire PackRat interface. This provides a pocket-sized learning tool that gets you up to speed in record time.

At Dustin Discount Software
there are thousands of products
in stock, with the lowest prices
on the very latest versions of
every package. In addition,
Dustin offers its customers the
means to stay current—any
software package purchased
from Dustin authorizes you for
competitive and version up-
grades for when the need
and/or opportunity occurs.



TIPS, TRICKS & SHORTCUTS

Peachtree Accounting for Windows:
Tastefulness for Accounting

Peachtree Accounting

Accounting Made Easy

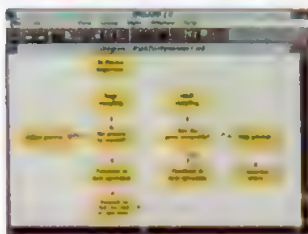
List Price: \$169

**DUSTIN
PRICE: \$125***Requires: Windows 3.1; DOS 3.1
or greater; 2 MB RAM; 7 MB hard
disk space.*

ing for Windows will make you look forward to balancing the books.

TIP Peachtree's Smart Guides allow you to become more familiar with both the accounting process and the Peachtree Accounting for Windows program by explaining what information is required and the purpose of the different features. The context-sensitive Smart Guides help you over the learning curve, but don't stand in your way once you are up and running. When you feel comfortable with the program, just turn them off.

allClear for Windows:



allClear for Windows

Flowchart Tool

List Price: \$299

**DUSTIN
PRICE: \$195***Requires: Windows 3.1; DOS 3.0
or higher; 2 MB RAM; 2 MB Hard
disk space; Mouse.*

Peachtree, the first name in small business accounting software, now offers an easy-to-use package designed for small businesses new to accounting. Peachtree Accounting for Windows includes dozens of powerful, easy-to-use features. They include an intuitive icon bar, features screens that resemble the forms they represent (checks, invoices, etc), a facility to add notes to transactions and the ability to customize all aspects of the program. Peachtree Accounting

Flowcharts and diagrams are an essential part of business communication. Many executives, however, don't have the time, energy or artistic instincts to produce these charts themselves. With this in mind, allClear for Windows automatically creates exciting and explicit visuals from a text file, without requiring any drawing, dragging, dropping or designing. It saves

MKS RCS:
Coordinating Software Projects

RCS

Revision Control Software

List Price: \$395

**DUSTIN
PRICE: \$229***Requires: Windows 3.1, DOS 3.1
or higher, VGA, 4 MB RAM; 2
MB hard disk space.*

see this increased productivity translate into bottom-line savings.

Many software developers who automate most of their corporate functions still spend a lot of time locating files, organizing files and verifying they are using the correct file revision to build a software release. With MKS RCS, you are given the tools to manage your software resources and improve how you create and release a software product. Not only will you improve file control, you will immediately benefit from an improved work environment. You will

TIP MKS RCS includes substantial disk space savings. Different revisions are stored in an archive file—a single file that houses the original and any changes made to the program by you or any of your colleagues. You don't store the whole of each revision, only the differences between them. And with large, executable files, this saving can be significant. You gain the freedom to concentrate your efforts on development.



time and money, and eliminates retraining required to produce compelling diagrams and minimizes the possibility of embarrassing mistakes or unattractive visual elements. Ultimately, allClear for Windows helps you to more effectively transmit important messages. And the ability to show these messages with clear, easy-to-understand visuals will improve communication both within your company and to the outside world.

TIP allCLEAR for Windows lets you view the text file and the document on the same screen. This provides a dynamic link; as you update the text, the changes are immediately reflected on the diagram. If you want to update the information on an existing chart, you only need to change the text. A new document is then created automatically, with no redrawing required.



TIPS, TRICKS & SHORTCUTS

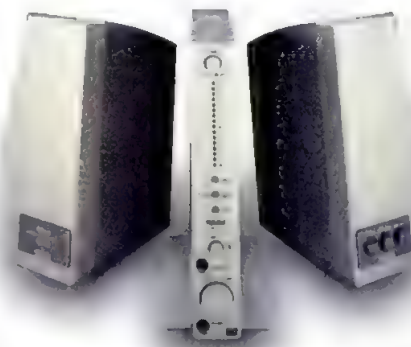
Hello!Music! Goodbye, Boredom

A PC without sound suffers from sensory deprivation. However, too many computers have sound capabilities that sound like, well, computers. For those who take their sound seriously, that just isn't enough. So Yamaha has introduced Hello!Music!, a PC sound system designed to produce superb sound across all computing platforms.

The heart of Hello!Music! is the Yamaha CBX-T3 tone generator, a slick-looking, compact sound module that contains digital recordings of 192 instrument sounds and ten different drum kits, along with digital reverb. Whatever sound you need for a presentation can be found in the Hello!Music! library.

Hello!Music! supports MIDI (Musical Instrument Digital Interface), the digital standard favored by musicians worldwide for the electronic reproduction of music. This gives it access to vast libraries of pre-programmed music for any occasion. Accordingly, the unit can also act as a connection between your computer and any one of hundreds of different MIDI devices. And an audio input jack allows you to mix in sound from any digital or analog sound device.

To provide a complete package, Hello!Music! includes first-rate MIDI software. Turbo



Trax, manufactured by Passport, includes three modules that will have you up and singing in record time. Trax operates like a tape recorder, for the recording and playback of music. MIDI Player lets you mix, transpose and change tempo, while QuickTunes provides the first step in building a great MIDI library.

You can enhance Hello!Music! with the optional #YSTM10H. These handsome units look small but put out some heavy-duty tones—attributable to the built-in 10-watt power amplifier driving the sound. These speakers provide first-class output, which will surprise those who have accepted the prevailing PC sound standard. These speakers are comparable to a fancy laser printer, when everyone else has a tired old dot matrix.

Today's PC users are discovering the importance of sound and how it can enhance a variety of applications. At the same time, they are finding a great disparity in sound quality between the PC and what they hear from their own stereos. While PC audio may be "adequate," it sounds poor by comparison. Hello!Music! narrows the difference, offering a logical upgrade for users with low-end sound cards as well as an exciting, high-quality turnkey solution for first time buyers who won't settle for second best.

Hello!Music!
Professional PC Sound
HELLO MUSIC
List Price: \$449
DUSTIN PRICE: \$275
SPEAKERS
List Price: \$149
DUSTIN PRICE: \$79
KEYBOARD
List Price: \$469
DUSTIN PRICE: \$309

Requires: Windows 3.1; 2 MB RAM; 386/SX or higher; open serial port.



TIPS ① Hello!Music! has the first MIDI interface that is compatible and interchangeable with DOS, Windows, Macintosh and laptop computers. So whatever you are using (and wherever you are using it), you can incorporate Hello!Music! with a simple flick of the switch.

② The unit is external and connects to the PC through the serial port. With no cards to install or rearrange, this feature is especially convenient for people who want to support their laptops with sound (as laptops have no slots and limited sound abilities). Hello!Music! can also be used with an existing sound card (via MIDI), to upgrade the instrument sound quality to General MIDI/CD Quality sampled sounds.

Dustin Discount Software's friendly, knowledgeable sales staff can guide you toward the correct software choice for your specific needs. A responsive technical staff supplies thorough after-the-sale service and support. Dustin employees are on the crest of the technical wave; all phone personnel have expertise in multimedia and CD-ROM.

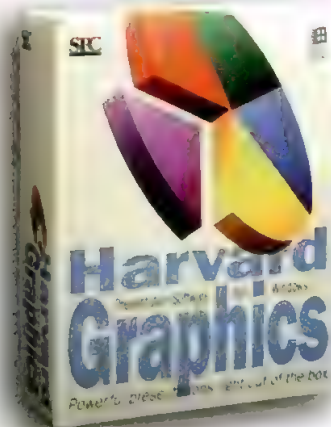
③ With such a high-class controller and speakers, Yamaha wouldn't allow any inferior user interface. The optional CBX-T3 MIDI controller is a thoroughly modern keyboard, with 49 full-size keys, touch sensitivity, modulation and pitch bend wheels.

④ Not only can you program the CBX-T3 to imitate any instrument, you can make it sound like any location. With the DSP (digital signal processing) function, you can select a variety of acoustical environments for your music—such as a grand concert hall or a small club venue. This is accomplished with Yamaha's proprietary AWM (Advanced Wave Memory) technology, which uses digitally recorded waveform data to yield superior sound. So you can add colors to the sound's style and substance.



TIPS, TRICKS & SHORTCUTS

Harvard Graphics 2.0 for Windows: Developing Ivy League-quality Presentations



Harvard Graphics 2.0 for Windows

Powerful, Easy Presentations

2.0

List Price: \$495

DUSTIN PRICE: \$255

2.0 UPGRADE

List Price: \$89

DUSTIN PRICE: \$89

Requires: Windows 3.1; 386 or higher processor; 4 MB RAM; 8 MB hard disk space (21 MB for full installation); sound support for multimedia playback.

make these ideas look their absolute best. Whether you're preparing charts for monochromatic handouts, adding a graph to a document or building a full-blown multimedia

In a short time, Windows has given strength and depth to the presentation category. Users can draw material and data from a variety of sources to create a compelling avenue for any business-oriented message. With its new version 2.0, Harvard Graphics for Windows raises the presentation ante, bringing new power and ease of use to the process itself.

While you still need to develop your own ideas, Harvard Graphics 2.0 for Windows can

business presentation, the program's unprecedented ease of use and flexibility give you the competitive edge in getting your message across.

Building presentations can be a complicated process. Harvard Graphics 2.0 for Windows has developed one of the most thorough help systems in any Windows application. Called the Advisor, this context-sensitive, on-screen help desk offers quick tips designed to help users edit the look and content of their charts.

Incidentally, it is the telephone that makes an exciting new presentation process possible. With Desktop Conferencing, you can display your presentation to 64 computers simultaneously during a telephone conference call. Here, your audience needs to log on to the assigned conference via the network, as the conference leader advances the presentation (and, at the same time, uses all of Harvard Graphics' embedded presentation features). The conference leader can pass control to any participant, who can then continue to run the presentation. And an internal messaging system allows participants to communicate without disturbing the conference itself.

At a time when everyone seems to have a short attention span and you have just minutes to get an idea across, Harvard Graphics 2.0 for Windows provides the tools to compete. You don't need to be an artist to create a stunning presentation; the ability to easily incorporate sound and video clips helps you to harness the power of multimedia. With Harvard Graphics, smart presentations are only a few mouse clicks away.

Harvard Graphics also includes an unprecedented breadth and depth of program help. As an example, What's New Help, a separate program group icon, leads you to the specific new tools in Version 2.0.

trial-and-error aspect of presentation design.

③ While showing a Harvard Graphics 2.0 for Windows presentation, you can use the On Screen Chalk facility, controlled by the mouse, to highlight key points, concepts or charts. These highlights disappear the next time you show the presentation, or when you move to the next slide.

④ The easily customized icon bar in Harvard Graphics 2.0 for Windows speeds up the presentation process by offering single click access to the most often-used commands. You can quickly add, arrange or remove specific icons for the Outliner, Slide Editor, Slide Sorter view, so only the icons that are appropriate for the individual view will be visible.

TIPS ① Harvard Graphics 2.0 for Windows includes 31 professionally designed presentation styles that take the guesswork out of putting together great looking presentations. Each style specifies charting options, a color palette, a background design and font style that fit well together, so there is no danger of offending anyone's sense of taste or style.

② Throughout Harvard Graphics 2.0 for Windows, Quick Looks allows users to experiment with different options without changing the current slide. This "what if" facility lets you see potential changes through interactive chart miniatures, providing instant visual feedback on how a chart will look under certain situations. This safety net takes away the

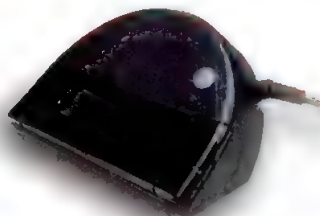


Customers interested in any presentation management package are not only interested in the best program available, but in the greatest efficiency and economy when shopping for such software. Dustin Discount Software provides both, with economic values such as free ground shipping, corporate accounts and no surcharge on credit.



TIPS, TRICKS & SHORTCUTS

Logitech Easytouch and CyberMan: Taking Input into the Next Century



Logitech Easytouch

List Price: \$299

**DUSTIN
PRICE: \$235**

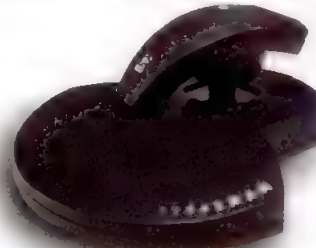
Requires: Windows 3.1; DOS 3.3 or higher; 4 MB RAM; VGA or higher; Logitech or compatible pointing device.

scanning, while the CyberMan provides the best way to interact with 3-D games.

ScanMan EasyTouch is designed for easy scanning with great results. You can scan anything from small, odd-sized items to large images. (The EasyTouch is only four inches wide, but its AutoStitch feature matches up multiple scans automatically and seamlessly.) The 256-level gray scale provides high-quality images for all types of output, and the optical character recognition (OCR) feature scans and recognizes text and inserts it into any Windows or DOS application. Once you have OCR, you'll never have to type copy in again.

Games have always been a big part of the PC experience, but it is only recently that it has been possible to simulate real-time 3-D graph-

A good mouse is necessary to use Windows effectively, as all of today's programs utilize point, click, drag, and drop. However, full control over the graphic user interface requires some extra desktop help, which Logitech provides: The ScanMan EasyTouch hand scanner offers portable



Logitech CyberMan

List Price: \$99

**DUSTIN
PRICE: \$89**

Requires: DOS 5.0 or higher; Serial port; 9 to 25 pin adapter if needed; 3.5 inch disk drive.

would do in real life. In this respect, the game becomes all the more real with no virtual reality needed.

CyberMan is a three-dimensional, interactive controller designed for the PC game enthusiast who wants the most advanced game experience possible. By simply moving your hand, you execute an on-screen action similar to that in real life. This includes vertical control (jumping and crouching, etc.), pitch control (leaning and lying, etc.) and yaw control (looking around corners and spinning). CyberMan is also the first mainstream computer product to incorporate tactile feedback, where you can feel signals during the game.

With these new products Logitech has emphasized its place as a manufacturer of the most ergonomically savvy input devices.

ages, even adding color highlights to black and white or gray-scale images.

4 CyberMan is compatible with existing mouse drivers, so it can be used in place of your existing mouse. Or you can incorporate "dual mode" to use CyberMan in conjunction with your existing mouse (as long as you have a separate serial port for each device).

5 CyberMan is backward compatible with the mouse. While it might take some time for game vendors to take advantage of all of CyberMan's capabilities, you can still play current and past games with no readjustment. For games that require both the mouse and the keyboard, CyberMan takes the place of both—resulting immediately in a more intuitive, exciting gaming experience.

TIPS 1 The ScanMan EasyTouch is easy to install, fitting right into your existing parallel port (which it shares with your current printer). There's no need to install a board (like with other scanners) or worry about confusing IRQ and DMA settings.

2 When you scan any image, it is transferred into your computer in a graphical format. The included OCR program—OmniPage Direct, supplied by Caere—then converts the scanned text from the graphic to the text format as it adjusts for text contrast and brightness. So you may never have to re-type a document again, thanks to EasyTouch.

3 ScanMan EasyTouch also includes FotoTouch color image editing software. This powerful tool allows you to enhance monochrome or color im-



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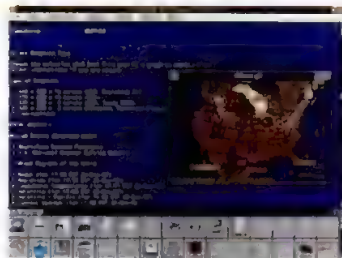
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Toolkits

REVIEWS OF THE LATEST TOOLS FOR THE PC PROGRAMMER

Edited by Sheryl Canter

CodeWright 2.0: A Flexible, Powerful Windows Editor

BY RICHARD HALE SHAW

Don't jump to the end of this story to read the conclusion. I'll tell it to you right now: When it comes to Windows-based programmers' editors with megawatt power, CodeWright 2.0 for Windows (\$249 from Premia Corp.) is one of the best. CodeWright's power and flexibility are virtually unlimited. It offers both CUA- and BRIEF-style command sets. Its use of Windows' multiple document interface (MDI) lets you open multiple files via multiple windows. Its flexible interface is fully customizable, even on a per-window and per-file basis. And its engine is contained in a set of DLLs, which makes it unusually customizable.

FEATURE-PACKED

This software developer's dream is so feature-packed that we can't do it justice in a one-page review. Here are just a few of its most thoughtful features: Its floating toolbox has buttons to lowercase or uppercase selected text. It can match and highlight the curly braces used in C and C++—for example, adding a matching pair of braces after you enter a FOR or WHILE statement. It can use a syntax-highlighting and -coloring scheme similar to that used by Visual C++ and Borland C++ to display program source code, and there are templates to support appropriate indentation stan-



dards. Pascal, dBASE, and PAL are also supported.

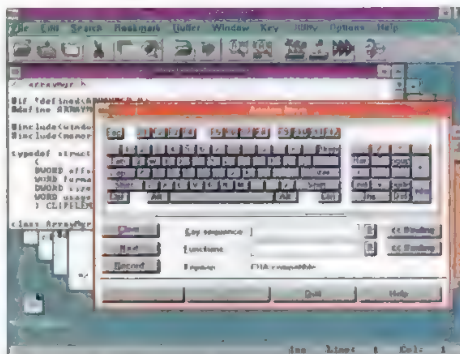
Since CodeWright is an MDI application, you can open many separate files in different windows on the screen and work back and forth between them. CodeWright is even flexible enough to let you change settings within individual windows. With unlimited Undo and Redo, and a line length and file size limited only by the amount of RAM and disk space in your system, CodeWright can handle the most demanding big-file chores. Its hex-mode editing feature makes binary editing a snap. You can copy or move text with the mouse, select columns using the right mouse button, and create a new file window just by clicking on the CodeWright window background.

The advanced user will find plenty of rare goodies. CodeWright has built-in GREP, file-find, file-difference, and file-merge capabilities. It supports full document-version control. It offers a complete, multiwindow, regular-expression search-and-replace capability. Its selective display mode displays only the text lines you specify (this lets you remove #IF DEFed code from view). Its keyboard can be completely remapped.

CodeWright isn't just another pro-

gram editor. Need to display status help? Just move the mouse pointer over a toolbar button; there's no need to click it. Want to select multiple files or invert the file selection list? You can do it all in the File Open dialog box. Need to print a program listing with custom header, footer, and title for each page? Use the Print dialog.

The System Options, Buffer Settings, and Window Settings dialog boxes let you change just



CodeWright's Key Bindings dialog box lets you assign any key to any task or function.

about every aspect of Code-Wright's behavior. You can set up the program to minimize or maximize its main window on starting, or ask it to save all files and windows on exiting and restore them all on restarting. You can use an arrow cursor (versus the standard I-beam) while editing, hide the cursor while typing, or even control the key-repeat and delay rates.

AN EDITING API

Most editors handle customization through a macro language. CodeWright takes a completely different approach, allowing you to add functionality using your programming language of choice. CodeWright comes as an executable file containing the editing engine, plus a host of DLLs. You can call the core

DLL from your own applications by way of a documented API (application programming interface), and ancillary features are contained in separate DLLs for which the full source code is supplied, so you can call them from your own applications. Indeed, you can modify or replace them altogether. You can even use the CodeWrite engine within your own applications, without any royalty fees.

CodeWright's API includes functions to intercept the CodeWright event manager, modify the menus, toolbar, and toolbox, and programmatically control other CodeWright features. The API lets you manipulate file buffers and windows, load and execute a compiler, move or hide the cursor, and run the search-and-replace or file-difference engines. You can control editing, retrieve and modify settings, remap the keyboard, invoke dialogs, and call the version-control system. You can directly call and execute CodeWright's API functions (over 670) from a prompt window.

CodeWright is a powerful and flexible programming editor. Windows NT programmers will be happy to know of an NT version now in the works. If your editor isn't quite all you want, you needn't live with it. Give it up for CodeWright, one of the best Windows-based text editors around. □

• CodeWright 2.0 for Windows
List Price: \$249. Requires: 4MB RAM, 1.5MB hard disk space, Microsoft Windows 3.0 or 3.1. Premia Corp., 1075 NW Murray Blvd., #268, Portland, OR 97229; 800-547-9902.

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Michael J. Miller

Travels with Myself and Another

Do you know the way to San Jose? And once you get there, what are the best restaurants, hotels, and things to do? Those are the kinds of questions that several new software packages are trying to answer, with varying degrees of success.

As someone who travels a fair amount of the time, the idea of having a really informative and really up-to-date software travel advisor available both before my trip and during it is enormously appealing. I've been looking at a number of programs that try to answer some tough travel questions.

And I haven't been disappointed. In the last few months, we've seen a lot of great new travel planning packages that contain extensive information on individual cities and locations. (For more details, see "Four Programs Tell You Where to Go, What to Do," First Looks, April 27, 1993.)

For basic information on hotel, restaurant, and sightseeing in 39 cities, TravelData Co. of Santa Barbara, California offers PC Travel and Entertainment Guide, a \$34.95 DOS-based database that is updated every six months or so. Although the user interface is very plain, with about as much aesthetic appeal as an American Airlines flight schedule, the information is copious and up to date. You can also make note of special corporate deals your company maintains with hotels.

If you want to find your way around a city, you will need a program with maps. Even here, you have lots of choices. The Software Toolworks of Novato, California offers Travel Companion, a \$79.95 DOS program that includes basic maps of the top 25 U.S. cities, plus information on hotels, restaurants, and sightseeing from the Frommer's Guide books. It isn't the most comprehensive guide available, but it does let you enter your own information so you can keep track of the places you like to go. As a bonus, it lets you keep track of your expense account information.

For Windows users, Local Expert from Strate-

gic Mapping of Santa Clara, California combines somewhat more detailed maps, plus local information and global atlas facilities. The basic \$99 program includes atlas information with simple maps of the world and specific region. The real help comes when you add one of the "City Map Sets," which cost \$25 each and are available with monthly updates for \$15 each. Each of these sets contains a map of the city. They aren't the most detailed available, but they do give you a general overview of the layout of each city. The strength of the program is its basic hotel, restaurant, and travel info. Rather than try to list everything, Local Expert presents the best in each category. Better still, Strategic Mapping really tries to promote its own update program by including details about cultural events that will be going on while you're visiting the city.

Another Windows program, AmericaAlive Navigator from MediAlive of Sunnyvale, California offers more visual information on places you might like to visit. It has simple maps, some basic travel information, and even slides showing tourist attractions. It doesn't have much information on any individual city, but the \$129 package could be great for planning a scenic trip.

If you want accurate maps of a city, I've seen only two packages that really deliver: City Streets from Road Scholar of Houston, Texas and the Zagat-Axxis CityGuide from Axxis Software of Haverford, Pennsylvania. Both offer very detailed street maps from Etak, which is known as one of the premier providers of maps in electronic format. These maps can offer incredible detail, but the obvious tradeoff is that they can be both expensive and large. For example, the maps that I looked at in these programs ranged



Today's personal travel and mapmaking software is good, but the best may be yet to come.

Michael J. Miller

from 7MB to 12MB per city.

Of the two programs, City Streets is the simpler. This DOS-based program offers very detailed maps of a city. You can help zoom in on different parts of the city, locate places if you know the address, figure out the distance between places, and draw and print route maps. Although the installation program is antiquated, the program itself runs well and is surprisingly fast, given the redrawing it has to do. It costs \$99.95 including the first city and \$49.95 for each additional city, with about 150 cities available.

HUNTING FOR RESTAURANTS

Zagat-Axxis CityGuide stands out by offering both detailed city maps and some of the best information on hotels and restaurants you can get. You choose restaurants by location, cuisine, price range, or by Zagat Guide ratings on food, decor, and service. By combining criteria, you can find a Chinese restaurant that stays open late within one mile of your hotel. Similarly, you can

find a hotel by location, size, cost, or by Zagat ratings on the quality of the rooms, service, and dining. In either case, you get quite an honest and informative assessment of the hotel or restaurant.

Like City Streets, the Windows-based CityGuide includes detailed maps. You can search for specific locations, and it will also point out the location of the various hotels, restaurants, and landmarks you select. If there is a drawback, it is in the size of the program and the limited availability of cities. CityGuide is currently available only for New York, Chicago, and San Francisco at \$99 each or three for \$249; other cities are under development. The New York data takes over 7MB; San Francisco, 12MB.

All of these programs can be helpful tools if you are traveling or planning a trip, but none really goes the distance as a directional aid. CityGuide is the only one that tries with a built-in route finding function. You set the start and finish points of your trip, and it then both draws you a map and gives you printed directions. It sounds neat, but in reality it works best for short trips.

Ask to go from, say, One Park Avenue, our home base, to Grand Central Terminal, a half-mile trip in a straight line, and the

program does fine, though it gives you directions in mile distances instead of blocks. However, ask to go from One Park Avenue to La Guardia Airport, a slightly complicated 30-minute drive, and the program must churn away for several minutes before it coughs up a route. Almost every taxi driver I've encountered can do a better job. And if you're in San Francisco, it can show you San Jose on the map, but it can't give you directions on how to get there.

THE FUTURE OF ELECTRONIC MAPS

For that, we may have to wait for the next generation of software with more sophisticated routing information and detailed maps. I can imagine using it on a portable computer or a personal digital assistant (PDA) to find out how to get from one place to another. It might be particularly nice in conjunction with a Global Positioning System, a satellite-based system that could tell the computer exactly where I was. Imagine what happens when computers have position information, as well the ability to store and process more information. Sometime in the future, a computer might really be able to answer yes to the question, "Do you know the way to San Jose?" □



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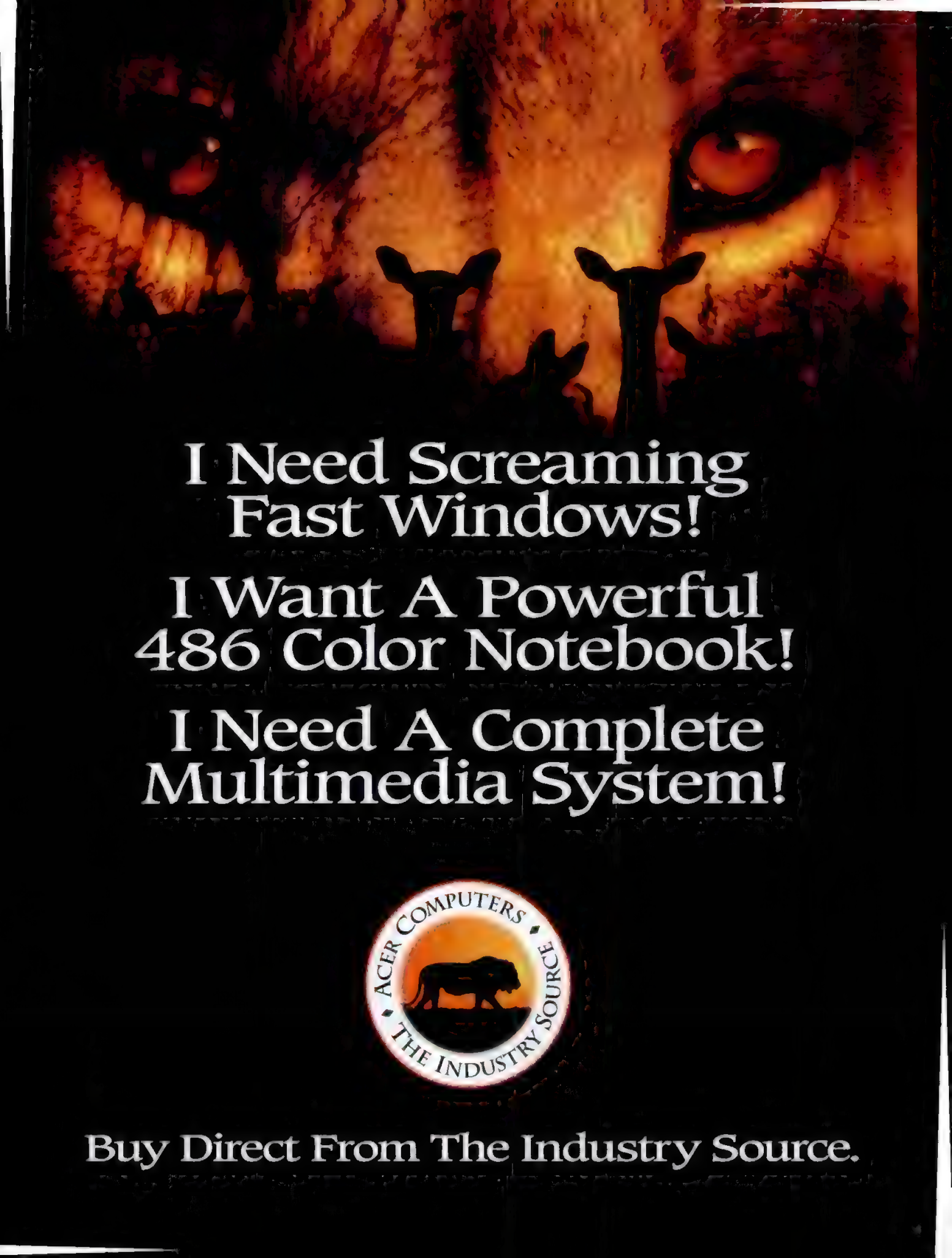
"Beyond the basics, Check✓It PRO reports on detailed drive mapping with suitable disk controllers and on the kind of UART your serial ports are using. Adding to Check✓It PRO's appeal is a set of benchmark comparisons that allows you to make sense out of the numbers that the benchmarks produce. If you get the SysInfo package and have any interest in diagnostics, you should consider the bundle of SysInfo & Tests and Tools."

"Quality of information is the key to a good reporting tool. As such, the program of choice for DOS users is TouchStone's Check✓It PRO."

— PC Magazine, July 1993

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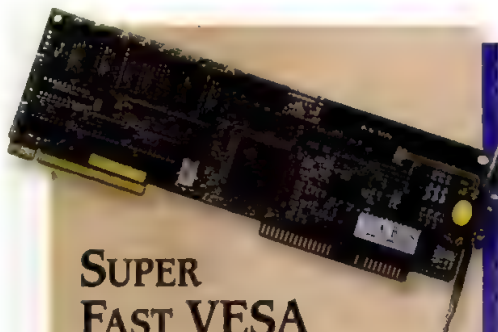
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- 170MB Hard Disk Drive and CD-ROM Drive
- 1.44MB Floppy Disk Drive
- 16-bit Sound Card and Speakers
- 1MB VESA Cirrus Logic Graphics Accelerator
- 14" .28 Non-interlaced Color Monitor
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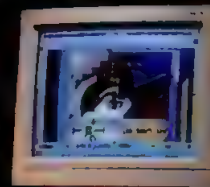


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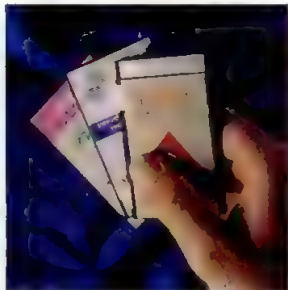
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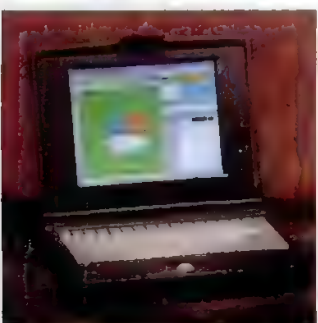


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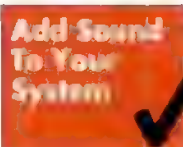


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Bill Machrone

SOHO Meets BOHO

I disliked the marketing acronym SOHO (small office, home office) the first time I heard it, and I'm not feeling any more kindly to it at the moment. It suggests, or rather vehemently insists, that there are products uniquely suited to a special

kind of user who works in a small office or at home. Most manufacturers who have bought into the idea of SOHO see it as a way of selling their lower-priced products to a smaller market, achieving marketing efficiencies by talking to fewer people in a way that they'll understand and respond to.

Hogwash. Small businesses may be on tight budgets, but in these days of downsizing, big-company equipment budgets aren't exactly overflowing either. I also reject the notion that smaller businesses don't need as much power as big businesses. Everybody wants as much power as they can afford. Further, the vendors are doing themselves a disservice if they fail to present their full product lines to their BOHO (big office, head office) customers. I'll grant you that users in small offices have to be more self-reliant. There's no IS group a phone call away, and using a local dealer as your IS department can be expensive. Support is where the difference between SOHO and BOHO begins and ends.

The marketplace is a puzzle that we all must solve. The cleverest, best-performing, most cost-effective solution wins. In order to play the game, you've got to be able to look at all the offerings. One of the most interesting I've seen lately is Star Micronics' SJ-144 color printer. Star is touting the feature set as ideal for SOHO. Which means that it may be interesting to you, no matter what size your office.

The SJ-144 follows the current vogue of standing the printer on its nose, with a paper feed that angles out behind it. It takes little desk space and makes access to the ribbon carrier a breeze. Ribbon? Just as the world seems about to be taken over by ink jets and lasers, along comes a ribbon printer

that's worthy of your consideration. The SJ-144 uses a 360-dpi thermal print head and a wide ribbon that prints two or more lines at a time when you're printing text. The ink is polyester, which lays down a fine, dark image on your page. There's no wicking, bleeding, or smearing, and unlike wax, the ink won't crack or slough off, and it's impervious to heat damage. Unlike ink jets, the SJ-144 doesn't require a clay-coated paper to do its best work. You'll find that it works just fine on standard 20-pound copier paper, although for your most important jobs you'll probably want to use Hammermill's 24-pound, long-grain paper for its superior feel, whiteness, and opacity.

The right ribbon for the right job is central to the SJ-144's charms. Of course there's the standard black ribbon, and two color ribbons. The first color ribbon is designed for printing on paper, where the ink reflects colors. The second is for overhead presentations, where you transmit light through the ink. The standard ribbon will make a decent transparency—better, I think, than the ink jets I've used. The colors from the overhead ribbon are noticeably more vibrant.



*A little printer goes a long way—and
where you use it, at home
or at work, doesn't really matter.*

DIFFERENT STRIPE

If you're designing a color printer and you've decided that it's to be ribbon-based, you've got two choices. You can arrange the colors in horizontal stripes that run the length of the ribbon, or you can have segments of cyan, magenta, yellow, and black that cover the full width of the ribbon and follow each other in sequence. Star took the latter route because the polyester ribbons are single-pass: Once you've run the ribbon through, you throw it away. So you would never print text with the

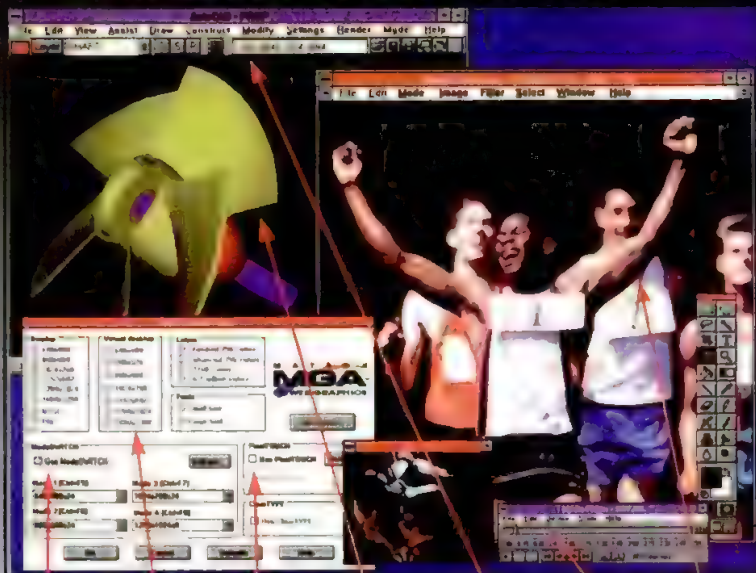
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Bill Machrone

color ribbon in place—even though the black segments are three times longer than the color segments, you can never go back to the color segments that have passed by unused during extensive black printing. Fortunately the ribbons snap in and out easily, and the polyester ink doesn't come off on your fingers unless you're running a fever in the hundreds of degrees.

DOMESTIC DUTIES

In order to test Star's claims to home-office versatility, I took the SJ-144 home (it's small and light) and hooked it up to my Gateway DX2/66. I installed the Windows driver and made a few test prints. Then I turned to my e-mail. Next thing I knew, it was bedtime. When I came home the next day, my kids greeted me at the door, proudly brandishing a handful of pages. They'd been into the CorelDRAW CD-ROM, and printed images that they found interesting. My 11-year-old daughter proudly displayed an oriental yin-yang symbol, all glossy black and pure white. I could only think of all the color segments that went by, unused, as she printed it. My son, 8, showed me an F-15 in flight. Of course it was black and white, except for the tiny, red, white, and blue air force symbol just visible on the wing. At least he got some use, however small, out of the color segments.

Did I get mad? With the little that was left of the ribbon, I printed out a cuddly koala bear from Corel, and a .GIF file of a colorful British train in the station. A man should always try to be a hero to his children.

There's one other ribbon, and it's sheer fun! It produces stick-on labels, just like one of those Brother P-Touch labeling systems. Only you don't need a dedicated \$150 box, just a special ribbon cartridge. You can make labels as long as you like, using type sizes up to the width of the ribbon. You can even do multiple lines of smaller type. The cartridges come in a nice variety of colors. We went slightly mad with it, cranking out labels for all manner of objects around the house that didn't really need them. The storage drawers in my shop area in the basement are all labeled, despite their contents, like promissory notes. The label cartridge is icing on the cake; this printer is just the thing for SOHO. Or BOHO. But especially YOMO (your office, my office). □



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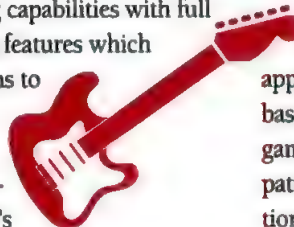
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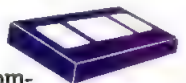
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In ordinary passive matrix displays (inset photo), colors are less saturated, and fading at the edges is common. With dual scan technology (on screen), color is richer, more uniform—with quality comparable to a great desktop monitor.



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John C. Dvorak

Windows NT: Workstation Killer

There is so much controversy over Windows NT that it seems the real purpose and intent of the product has been lost in the analysis. NT was created for the sole purpose of destroying the market for workstations and strengthening the posi-

tion of the PC. Hear me out on this one.

I think everyone has been somewhat mystified about NT and its reason for existence. Microsoft makes all its money selling desktop-computing operating systems and applications that run under the ever-changing DOS/Windows environment, as well as applications for the Mac and OS/2. What's the point of NT—the portable version of OS/2? Remember, it had been called OS/2 3.0. Why would Microsoft bail out of the general-purpose Intel-based OS/2 (where the action is) and stick with this odd “portable” product?

Well, Microsoft has analyzed the workstation business, including the business of Sun Microsystems—a company that has taunted Bill Gates over the years. Microsoft sees the obvious: The workstation business follows the same *modus operandi* from company to company, and the M.O. is not much different from that of the archaic minicomputer business of years gone by. All that has changed is the phraseology. You have an expensive machine that uses a proprietary CPU and a proprietary operating system. Today's workstation marketers have tried to convince the world that they do not use proprietary chips or operating systems. After all, anyone can use a SPARC chip, and the MIPS chip is for sale, isn't it? And Sun loves to talk about how “open” its system is. Finally, they all point to the fact that they use Unix. What could be more “open” and nonproprietary than Unix?

A closer look reveals all this to be total bull. In fact, the various systems *are* proprietary. Only Sun uses the SPARC chip to any commercial degree. And the Sun version of Unix is hardly universal. Silicon Graphics uses the MIPS chip and its own ver-

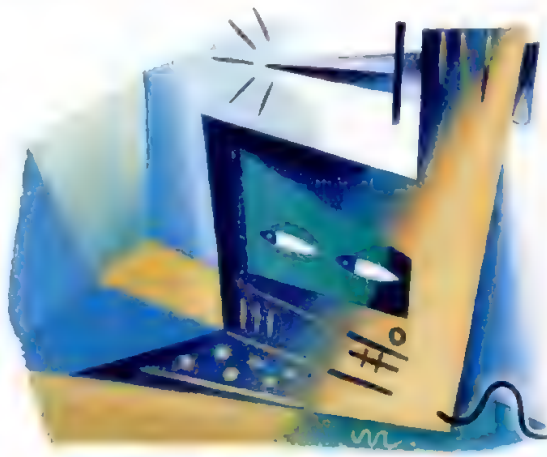
sion of Unix. DEC uses the Alpha chip and VMS or Unix. Name a minicomputer—oops, I mean workstation—and you'll find a *de facto* proprietary chip and a modified version of Unix that is hardly standard fare. And the only reason that any of these guys use Unix is because Unix gives them a head start on operating system development. Who needs to reinvent the wheel?

Enter Microsoft. Microsoft sees that this basic Unix going into these machines is old-fashioned and unchallenged. How about developing an operating system that is superior to Unix and offers a nice user interface? Forget X Windows hassles and the agony of the Motif shell. Just license Windows NT and you get it all. And golly, Microsoft will even help you get it running on your hardware, Mr. Workstation Man!

Therein lies the rub. What happens when the suckers in the workstation business put Windows NT on their machines? They suddenly become familiar with the Windows look and feel and begin to compare the workstation to the PC. Hey, now they *really* look the same. And guess what? The performance of the cheap desktop PC is not that far behind that of the expensive worksta-

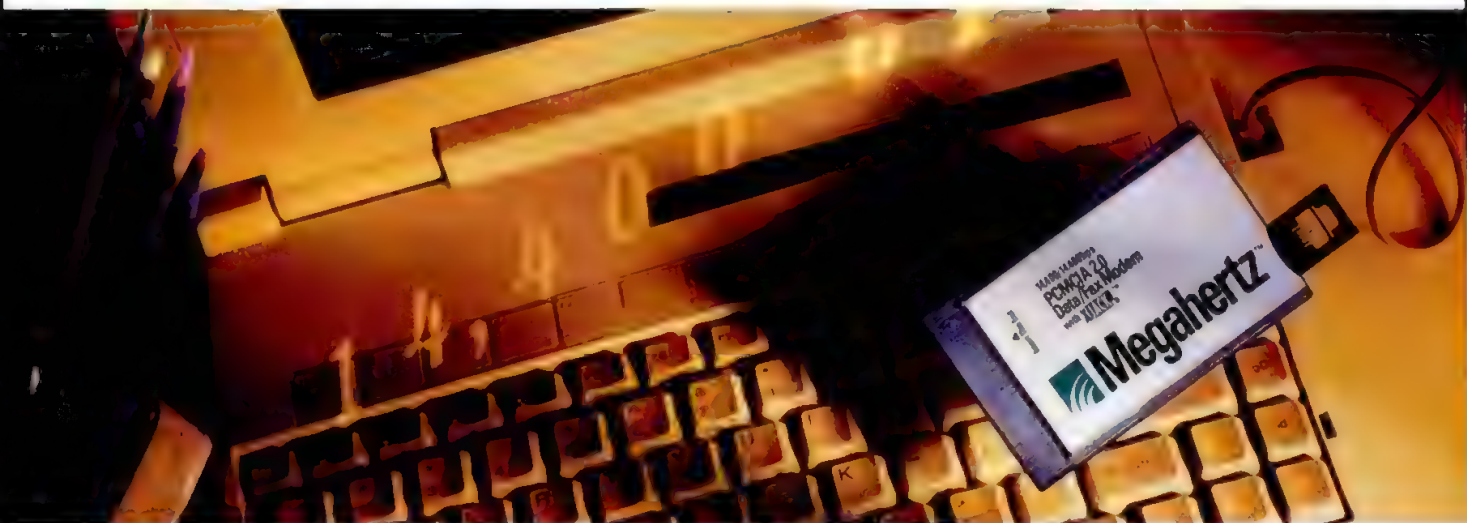
tion. In fact, it might be better for the PC if the workstation is bogged down by NT. All the PC needs is a big screen to look exactly like the workstation, too.

This may be another reason Microsoft split with IBM over OS/2. The plan to migrate everyone to the PC requires that OS/2 3.0 (oops, I mean NT) look and feel just like Windows, not Presentation Manager with its Workplace Shell. IBM with OS/2, PowerOpen, and Taligent/Pink may have wised up to this Windows *über alles* scheme, but I doubt anyone else has.



*Aha! Suddenly it's obvious
why Microsoft
is pushing Windows NT.*

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Inside Track

S

ymmetric Multiprocessing Capability, SMC

Dept.: This is the concept of using more than one CPU per computer and actually taking advantage of the two chips nearly **doubling performance**.

A few years ago, there was a whole series of arguments about the advisability of coprocessing, multiprocessing, and parallel processing when Microsoft and others stumbled onto the latest buzz term: symmetric multiprocessing. It's used as a **gimmick** to boost sales of Microsoft NT. It's less well-known that OS/2 has since been SMC-enabled to do the exact same thing, and the upgrade will be available when an actual multiprocessor machine is delivered. That might be sooner than you think. Most of the major clone makers are planning to introduce multiprocessor 486 machines. **The first wave** of these machines will contain two 66-MHz 486 chips. Look for machines that have an upgrade socket and can be made to use both the upgrade chip *and* the existing older chip simultaneously. Intel has been looking for a way to **double its sales** of microprocessors. This should do it.

Low Profile Dept.: If any company has kept a low profile in the PC arena, it has to be IBM's \$6.1 billion AdStar business unit, which produces all sorts of **odd disk drives**. For one, the company has developed a line of interesting optical drives, including some 3.5-inch models that hold a gigabyte each, as well as a line of 2.5-inch models headed toward a gigabyte. The majority of these drives are IDE, further pushing IDE as the de facto disk drive standard for magnetic as well as optical media. The word on the street is that AdStar is working on a **super-high-capacity 2.5-inch magnetic drive**, with the goal of being able to provide a gigabyte of disk memory for the IBM line of laptops.

Does Anyone Ever Read These Things? In a recent press release, Microsoft quoted a slew of executives from various computer companies who were fawning all over Windows NT. My favorite quote comes from Jess Lipcon, VP of the Windows NT program for DEC: "The introduction of Microsoft's Windows NT operating system represents a new era in pen, client/server-based computing..." Can you imagine a **client/server system running off of a pen-based computer running under NT?! Yikes!** I think I'll ask the guy who does the Zoomer pen-based pocket computer if he plans to port NT anytime soon!

Symmetric

multiprocessing

is a buzzword used to

boost sales of Windows

NT. It's less well-

known that OS/2 will

be SMC-enabled

when multiprocessor

PCs ship.

Programming in India

Dept.: The real reason for object-oriented programming is so that **cheap foreign coders** can write modules to be included in expensive programs. Even the Japanese are getting into the act. Fujitsu just invested 300 million yen to set up a software firm in either Chandigarh, Punjab (in northern India), or in New Delhi. I've seen plans by an American start-up for **huge satellite links** to be put in India so the code can be sent directly to the States for use here. The thinking is that if you can specify a C++ module, it can be cheaply coded in India or elsewhere and then shipped back and added to the object library for use in a complex system. The Americans will do the user inter-

face, the Indians will code the objects. I've heard that coders in the People's Republic of China are another target of this scheme to **accumulate cheap code**. While this dream of cheap foreign code may eventually work for **large, bloated systems**, the best code is still done by small teams of young American coders eating pizza and drinking Coca-Cola. And I've yet to see any decent code come out of India.

Upping the Modem Ante Dept.: I noticed a lot of large BBSs promoting their use of the ZyXEL modem. These V.32bis (14.4-kilobit-per-second) modems come in a variety of flavors, from cheap to expensive. The expensive ones incorporate a couple of different high-speed super modes as well as leased-line connectors, voice capability, fax, etc. Anyway, I was stunned when my U-1496 Plus/Enhanced connected to a BBS hit a **Zmodem download cps of 2,205** while averaging at least 2,000 cps!! This modem runs **faster** than any off-the-shelf modem I've ever used. A **mind-boggler**. Contact ZyXEL (4920 E. La Palma Ave., Anaheim, CA 92807) at 714-693-0808 or fax them at 714-693-8811. **Hot stuff indeed.**

This Brings Me to the Punchline Dept.: So as I'm smokin' at 20,000 bits per second I read this clipping: "Interactive Systems Inc. is offering expanded public access to Federal Communications Commission databases. Communications Daily reported this morning the access charge is \$36 per hour for 1,200 bps and \$54 for 2,400 bps. CD says first-time users must call ISI at 703-812-8270 to establish an account before using system." Some service! Where do these **jokers** find these slow modems? Are they \$15 surplus modems or what? Anyone who offers a *new* service at these transmission rates and at these prices should check the calendar. **Hey guys, it's 1993!** □

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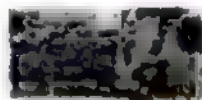
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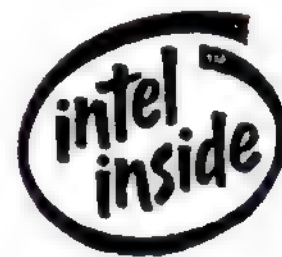


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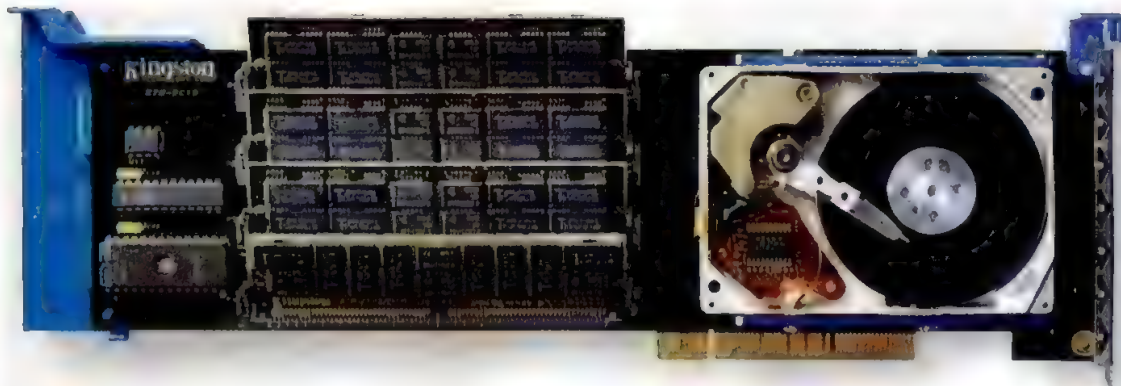


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Jim Seymour

Multimedia Myths, Shattered

The mythmakers are at it again. Or maybe I should call them naysayers, or a lot worse. These are the same people who assured you, for example, that desktop publishing was “only a technique, not an application”—and that clearly there’d never

be any such thing as the desktop publishing market. Now these people are hacking away at the notion of a market for multimedia.

Good thing we never asked them about the internal combustion engine. Or color TV. Or PCs themselves, for that matter.

I’ve noticed lately how often I hear what I’ve come to call The Four Big Lies of Multimedia. I run into this nonsense again and again, often repeated in the same words, and I’ve started to wonder: Is there a Typhoid Mary running around the country, infecting people with this bushwa?

Time for some debunking.

Big Lie Number One: *Don’t be fooled by all those people buying sound cards and CD-ROM drives. That isn’t a multimedia market in the making; it’s just a lot of impulse buying.*

Huh? What does that mean? If “a market” means a technology or group of technologies, embodied in products that are hot sellers now and for the foreseeable future—and these products seem likely to be incorporated into what we think of as mainstream PCs themselves—then how can anyone claim there isn’t a real multimedia market yet?

Take a stroll around the nearest Computer-City, CompUSA, Best Buy, OfficeMax, or other big computer retailer or superstore some Saturday morning. Look at what people are buying, what they’re arguing with each other about. It’s CD-ROMs and sound boards—often bundled together. The people have spoken, and multimedia is what they want.

Look, too, at the kinds of computers the mainstream PC makers are bringing out. Ted Waitt at

Gateway 2000 started the trend of putting CD-ROMs in almost every machine a company ships; now Apple and other PC makers are doing it, too. And the ones that don’t bundle CD-ROM drives with new systems make them such cheap add-ons that they’re nearly irresistible.

Seymour’s Law of PC Buying for Fall 1993: Buying a desktop PC without a built-in CD-ROM drive is a big mistake you’ll soon regret.

What’s happening out there, despite the naysayers’ grumblings, is the birth of a real and continuing market. The single most critical element in establishing that market is well under way today: building the installed base of multimedia-capable PCs.

Big Lie Number Two: *This stuff’s too hard for most people to do themselves. They won’t use multimedia authoring programs to make their own animated slide shows and video- and sound-clipped presentations themselves.*

Yes! Exactly! Did anyone think otherwise?

That’s just the point, in fact. The hottest corner of the PC business now goes by the clumsy name of *content publishing*: not selling tools with which to manipulate data (in other words, *programs*), but selling the data itself (namely, multimedia CD-ROMs).

Indeed, the multimedia CD-ROM publishing business is one of the biggest opportunities created by the personal computer. It’s a whopper of a chance for creative types, marketers, and PC resellers. The only question is whether we’ll see new fortunes made or whether a cabal of existing PC companies, such as Microsoft, and some of the old-line Hollywood entertainment producers, like Time Warner,



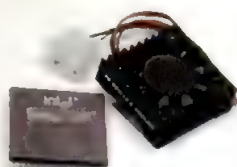
*Who says multimedia’s not a market?
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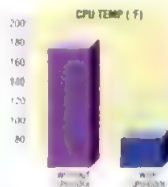


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Jim Seymour

rush in and gobble up the big bucks.

Of course, for mass-market CD-ROMs to really take off, we need a big installed base of multimedia PCs in place to provide the volume needed to drive the market. In other words, there's synergy at work here: In the chicken-and-egg relationship between multimedia hardware and software, the boom on each side drives the other.

Big Lie Number Three: *Even if you want to create your own multimedia programs, it's just too hard. You'll look silly.*

C'mon, guys; you can't have it both ways. Rather, there are a couple of possibilities: Either we won't roll our own and will make multimedia publishers rich, or we will make our own and will make the multimedia applications-software people rich.

In fact, we'll do both. You don't need an all-singing, all-dancing production, in the words of the old musical movie makers. It's perfectly legitimate to add some voice-over, maybe a few sound clips, and a little music to give some pizzazz to an otherwise flat, silent PC-based slide show.

If it's a selling job—and virtually every presentation is a selling job, whether you're trying to persuade people to give you an order, fund your school's program, approve your division's budget, or vote for your bill—then multimedia's extra zip can move your audience to agreement and action.

Finally, Big Lie Number Four: *Nobody really cares about this stuff.*

No? Watch your kids' eyes light up when dinosaurs roar into action—literally roar, even if only over your PC's internal speaker—when you run *Dinosaur Adventure* from Knowledge Adventure, a company that delivers very good multimedia without CD-ROMs, by the way.

Watch your spouse perk up when you plug Microsoft's *Cinemania* or *Musical Instruments* into your CD-ROM drive.

Watch your boss and the rest of the budget committee sit up and listen as you hit the third or fourth slide in a presentation using voice clips.

PC multimedia is real. It has many forms. It runs on a million personal computers today and will run on several million more by the end of the year. Hundreds of thousands of people use it every day in business, in schools, and in their homes. It's affordable; it's persuasive; it makes sense.

So, umm, how come "it's not a market," guys? □

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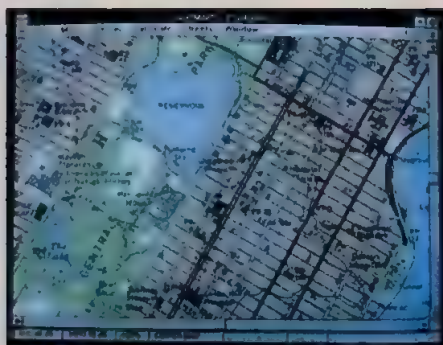


Delmer's first day in the new department doesn't seem to be starting off well. (But there's no finer monitor to show off a new hairstyle on than the MAG MX17F, with its 0.26 dot pitch. It's as close to hair-tbin as you can get.)

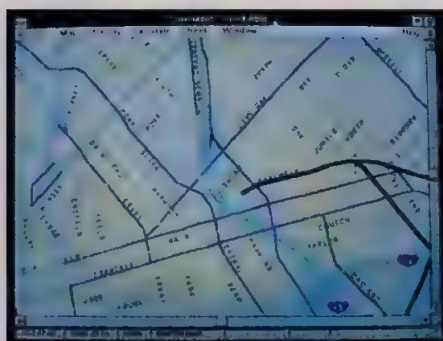
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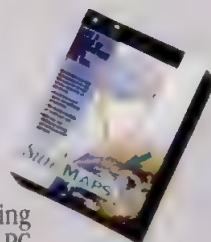
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Bill Howard

Your Next Laptop Will Be Color

The monochrome-display portable computer is dead. Today, if you do anything more than dabble with laptops, you owe it to yourself and to your company's productivity to choose color systems. And not just for the gold collar workers at the

top of the corporate food chain. Color today belongs in the hands of everyone who uses laptops.

Inexpensive passive-matrix color notebook computers today cost less than \$2,000. Good dual-scan color notebook computers from the best of companies cost as little as \$2,500. The very best active-matrix color notebooks run \$3,500 to \$4,000 and up.

The sweet spot of the market today is a value-priced 6-pound 486SX/25 or 486SX/33 (or SL) notebook with a dual-scan passive-matrix color display and a claimed 3-hour battery life. The Compaq Contura 4/25C and the Toshiba Satellite T1900C are two well-known examples. Others around \$2,500 include the AST Bravo NB 4/25s Color, Northgate ZXPortable/Dual Scan, and PC Brand LeaderBook 486.

What is dual-scan, or double-scan, technology? The display on a single-scan passive matrix LCD panel is refreshed one row at a time, meaning any row on your VGA display gets just $\frac{1}{480}$ of the computer's attention. If America's kids got that little quality time, it would be the subject of a Hillary Rodham Clinton task force. Dual-scan technology carves the display into top and bottom halves, and each row can be triggered for twice as long. Dual-scan is a hot buzzword today, but it dates as far back as the era of monochrome CGA laptops. If you see a faint horizontal band running across the middle of your monochrome laptop's display, you've got a dual-scan laptop.

If you were to line up three color notebooks shoulder-to-shoulder—passive color, dual-scan passive color, and active-matrix color—you'd judge passive color to be too washed out or muted, and you'd find active-matrix color to be clearly supe-

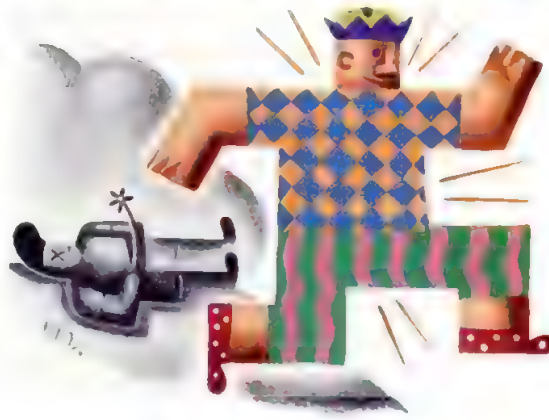
rior. You'd find the dual-scan LCD to be halfway between in quality, and highly acceptable. But dual-scan passive notebooks stand much closer to single-scan notebooks in price.

Color matters because graphical environments like Windows cry out for higher resolution, and color provides a substitute for the higher resolution you can't get on portables. Highlighted passages, system icons, and red negative numbers all pop out at you on color displays. Mono displays can generate 16, 32, or 64 shades of gray, but personally I can't see more than four.

You wouldn't put a great stereo in a Yugo, and a first-rate color display shouldn't be held back by an underachieving laptop platform. A well-equipped notebook today has 8MB RAM (not 4MB), a 200-300MB hard disk (not 120MB), and a 14.4-Kbps data/9.6-Kbps fax modem. You probably also want a spare battery, a spare transformer, and a port replicator. That pushes your \$2,500 best-value color laptop up to \$3,500. But as the price rises, the premium for color is a smaller fraction of the total price.

Of course, you want a 486-class CPU, and nothing less, on your notebook. If you're doing presentations, spend the extra money on active-matrix color displays that suffer none of the smearing and ghosting from rapid screen updates. (Dual-scan displays reduce but don't eliminate streaking.)

The only viable market I see for monochrome portables is for the occasional user who wants to check e-mail or finish a report on the road. If you don't mind using last year's technology, you can find closeouts on 386-class AST, Toshiba or Compaq systems with 80MB drives for \$1,000. □



Why are monochrome notebooks dead? Because color is getting both better and cheaper.

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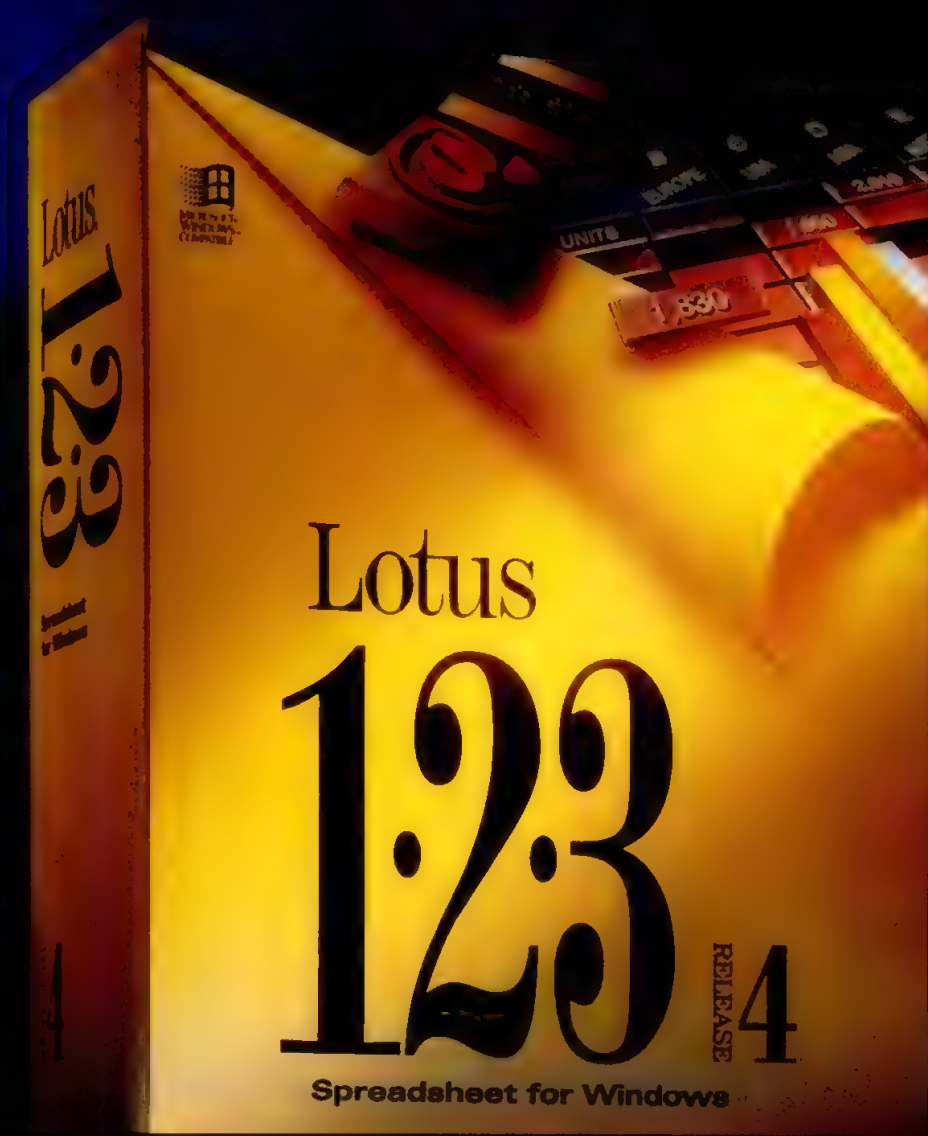
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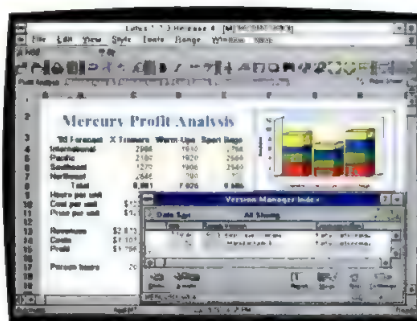
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PC/Computing 6/93

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Walter S. Mossberg
Wall Street Journal 7/29/93

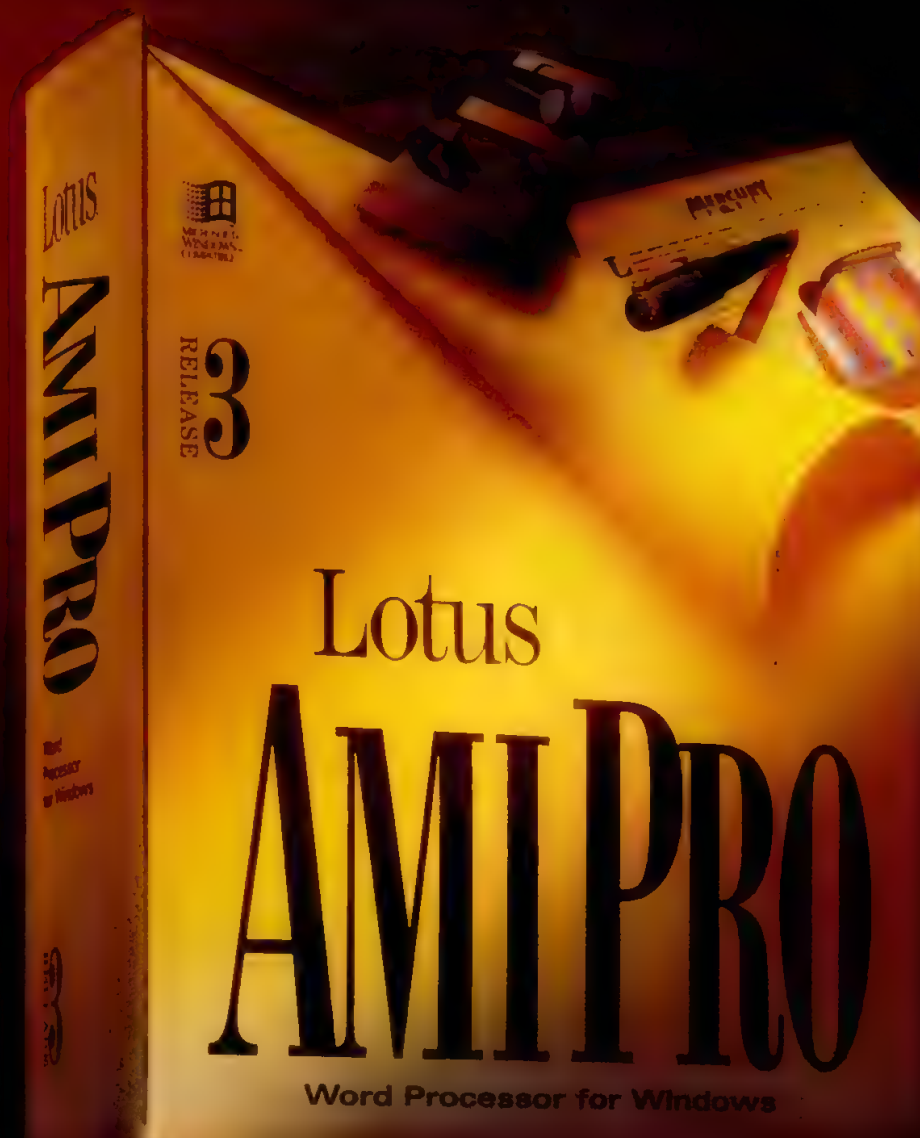
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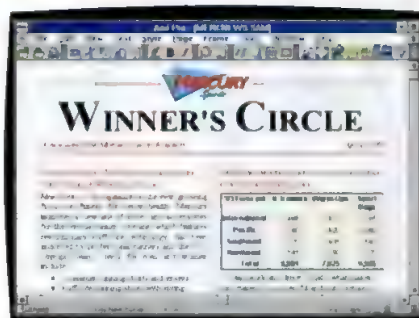
BYTE 6/93



Software reviewers and industry experts have convincingly and consistently chosen Lotus® Ami Pro® as the best word processor over both Microsoft® Word and WordPerfect® for Windows™.

Again in the August, 1993 *PC/Computing* Face-Off, Ami Pro soundly beat Word and swept both DOS and Windows versions of WordPerfect in 8 out of 8 categories.

If you're in the least nervous about leaving WordPerfect or think Word is the easiest way to face Windows, Ami Pro will feel like a breath of fresh air. Because no one comes close to Ami Pro for making even the most complex



documents fast and easy. Using customizable, editable SmartIcons® that give you one-click access to most tasks, and a SwitchKit that takes any trauma out of leaving WordPerfect, you'll understand why new Ami Pro users

rarely bother to open the manual.

Then consider the advantages of Ami Pro's tight integration with 1-2-3® and the other Lotus applications. With Ami Pro, you can not only exchange data, charts and functions with the other applications in a click, you can easily create hot links between applications.

Enough words. Visit your Lotus Authorized Reseller or call **1-800-TRADEUP, ext. 9087*** to order. Or ask for your free, full featured working model. Meanwhile, how happy are you with your presentation graphics software?

Lotus
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“AMI PRO

“Ami Pro 3.0 comes close to being perfect...It stands above Word and WordPerfect in both its function and in its speed.”

Home Office Computing 1/93

3.0

“You can learn to use Ami Pro, the Lotus word processing program for Windows, in about a day. Put the manual in a drawer as a first step.”

Forbes 2/1/93

TAKES THE LEAD OVER MICROSOFT WORD

AS THE WINDOWS
WORD PROCESSOR
TO BEAT”

—InfoWorld 9/28/92

“Usability, features and performance – Ami Pro is the overall winner.”

PC/Computing 8/93

“Users moving to Windows from DOS can fearlessly choose the latest Ami Pro Version.”

PC World 3/93

Lotus
FREELANCE



RELEASE
2

Lotus

FREELANCE

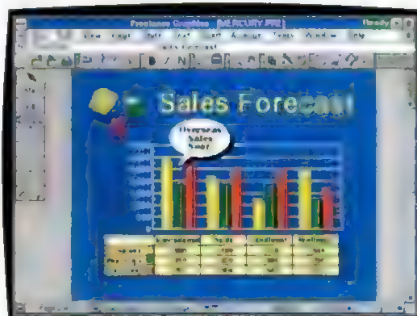
G R A P H I C S

Presentation Graphics for Windows

Year after year, Lotus® Freelance Graphics® has dominated both Harvard Graphics® and PowerPoint® in industry awards. This year, Freelance Graphics 2.01 has again set new standards, winning top ratings from InfoWorld, PC/Computing, BYTE and Windows Sources.

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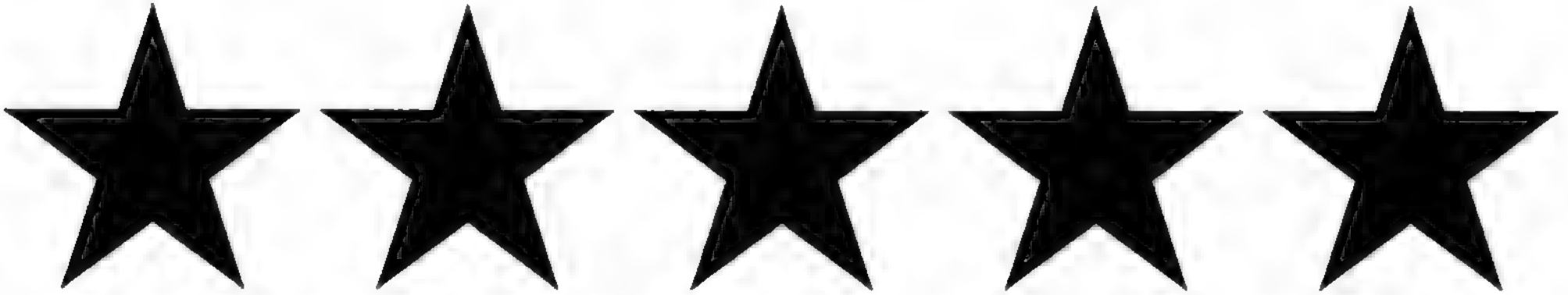
Lotus
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"Freelance is as close to presentation perfection
as you'll find on any shelf."

Windows User 8/93

"Creating a presentation of even (100 slides) is
absurdly easy--and much easier in many ways
than with competing products..."

PC Week 2/15/93



"LOTUS FREELANCE GRAPHICS_; FOR WINDOWS SCORE: 9.2"

— Software Digest 7/93



"MICROSOFT POWERPOINT_; FOR WINDOWS SCORE: 7.9"

— Software Digest 7/93

"(Freelance Graphics) outclasses the competition
in features and ease of use."

InfoWorld 6/21/93

"The users in this study were more productive, more
effective, and more satisfied with Freelance Graphics
than PowerPoint...PowerPoint users took 64% more
time to complete their presentations."

Usability Sciences Corp. 3/93

Lotus

APPROACH

Database for Windows

2.1



RELEASE 2.1

Lotus APPROACH

Database for Windows

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only to find they were unworkable, Approach will change everything. An independent study found that Approach users are up-to-speed and producing real results in two hours.**

And because Approach is designed to share with other Lotus Windows applications, using Approach databases to mailmerge with Ami Pro®, to share data with 1-2-3® spreadsheets, or to simply report on data is something anyone can do.

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Lotus
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"...Approach offers much easier-to-use database-creation tools for individual users, and easier access to big-time databases than either Microsoft Access or Paradox/Windows...Approach is a big, big winner."
PC Week 6/28/93

"APPROACH...
IS BOTH
PRODUCTIVE
AND
HIGHLY
USABLE. ACCESS WILL BE TOO
OVERWHELMING
FOR END-USERS..."

"...Approach 2.0 is one of the few (software) packages...for which it's truly possible to never open the manuals."^{††}

Windows Magazine 12/92

"Best Buy Approach is the simplest and most straightforward relational database."

PC World 6/93

—InfoWorld 1/17/93

"The most usable Windows relational database ever."
PC/Computing 8/93

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Lotus

SMARTSUITE

Five award-winning applications for Windows

The new Lotus® SmartSuite™ 2.1 is the most complete desktop solution for Windows™ users. It brings together 1-2-3® Release 4, Ami Pro® Release 3.01, Freelance Graphics® Release 2.01, Approach™ 2.1 and Organizer™ 1.1 at an irresistible price (upgrade for just \$299***). But it's much more than a deal on an all-star collection of Windows applications.

The applications in SmartSuite 2.1 are closely integrated, sharing a consistent appearance and behavior. This reduces the time it takes for a user to learn each application. For example, the three most used applications in SmartSuite share 26 common SmartIcons® (In Microsoft® Office, they share 3).

Far beyond anything possible with Microsoft Office, Lotus's integration also sim-

plifies the process of switching between applications, sharing information across applications and using functions from one application while working within another.

For example, you can easily edit 1-2-3 charts from within Freelance Graphics.

Or use Freelance or 1-2-3 functions within Ami Pro. All work easily with the Approach database. And all support industry standards, so they'll work with offerings from other vendors as well. This makes working in each

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in groups in ways Microsoft Office can't. All applications are network ready and mail-enabled with ccMail™. The results of Working Together® are easily manageable through 1-2-3's Version Manager. And each application features additional enhancements for full integration with Lotus Notes***.

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For the whole story, visit your Lotus Authorized Reseller. Until 12/31/93, you can upgrade from any Lotus or competitive

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Or for a SmartSuite demo disk, call

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“LOTUS SMARTSUITE REDEFINES

Lotus now has a top rated product in each of a half a dozen categories... Moreover, Lotus products have come to share a great deal of genuine integration...”

*Soft*Letter 5/21/93*

HOW

“When you buy...SmartSuite, the pieces really work together!...The point: There's more to a suite than cramming four boxes into a suitcase and cutting the price.”

PC/Computing 8/93

APPLICATIONS SHOULD WORK TOGETHER.”

“The level of integration in the SmartSuite makes complicated, cross-application tasks easier for users and lets them take full advantage of...the Windows environment.”

Dataquest 6/15/93

—PC Letter 6/7/93



*In Canada, call 1-800-GO-LOTUS. **Consult your Lotus Representative for more information on how to incorporate Lotus Notes and ccMail into your communication strategy. ***\$299 direct from Lotus. Offer expires 12/31/93. Qualifying competitive products are Microsoft Excel, Borland Quattro Pro (not including SE), Microsoft Word, WordPerfect, Wordstar, DisplayWrite, Microsoft PowerPoint, Harvard Graphics, Corel Draw, WordPerfect Presentation, Aldus Persuasion. Qualifying Lotus products include 1-2-3 (excluding 1-2-3 for Home), Symphony, Ami Pro, Freelance Graphics, ccMail and Graphwriter. Lotus Notes and Graphwriter are registered trademarks and SmartSuite and Lotus Organizer are trademarks of Lotus Development Corporation. ccMail is a trademark of ccMail, Inc., a wholly owned subsidiary of Lotus Development Corporation. Quattro is a registered trademark of Borland International, Inc. Wordstar is a registered trademark of Wordstar International, Inc. DisplayWrite is a registered trademark of International Business Machines Corp. Aldus is a registered trademark of Aldus Corporation.



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Pen Pals

The first PDAs are here! These tiny hand-held digital assistants usher in a new era in personal computing.

*by Christopher Barr and
Michael Neubarth*

A new wave of personal computers is rolling in. Known variously as personal digital assistants (PDAs), personal communicators, personal intelligent communicators, and personal information processors, these hand-held machines combine pen input, handwriting recognition, personal organization tools, and state-of-the-art mobile communications in tidy packages.

Our roundup includes the first group of PDAs to hit the market: the Amstrad Pen Pad PDA600, Apple Newton MessagePad,

Photograph by Dennis Blachut

PDAs

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AT&T EO 440 Personal Communicator, and Tandy Z-PDA/Casio Z-7000 Personal Digital Assistant (formerly Zoomer). Although the focus of our story is on PDAs, we have taken this opportunity to look at the wide variety of pen-based machines—general-purpose and vertical-market oriented—that are assisting people in their jobs and lives. To round out our coverage of personal solutions, we also look at the current field of nonpen-based personal organizers.

Are PDAs hype or the greatest thing since sliced silicon? The truth is a little of both. When measured against the ideal devices that many users have been led to expect, the first real PDAs fall short. Despite their limitations, however, we found them to be impressive machines.

We chose to use the term *PDA* for the new mobile machines because it has become the most universally accepted. (Amstrad, Apple Computer, Tandy Corp., Casio, Sharp Electronics Corp., and other vendors call their products PDAs, as does the general media.) The PDA vision (and name), first articulated by Apple chairman John Sculley, was a lightweight hand-held device serving as a personal organizer with wireless communications capabilities.

The ideal PDA enables a user to take notes, keep a calendar, schedule appointments, and send and receive data (text, voice, video), fax, and e-mail messages. It also gives users access to on-line services, letting them collect information (from corporate and personal databases) and perform electronic transactions (shopping, banking, travel, and so on).

The Newton incorporates intelligent

software, which includes handwriting-recognition and an "assist" feature that can link and automate tasks. A handwritten name and address can be translated into text and placed into an address or appointment application using action words such as *send* or *meet*. For example, you can write, "Call Mom," and the PDA will automatically access and dial Mom's number. Faxes and e-mail messages can be sent the same way (but only with wire-based modems, until wireless hardware and software become available).

While the Pen Pad, Newton, and Tandy/Casio are similar in size and concept, the EO is larger, incorporates more communications options, and is geared toward corporate use rather than use as a general-purpose device.

The Newton and Tandy/Casio each have infrared transceivers that let users beam information between their fellow Newton or Tandy/Casio users (within a 3-foot radius). A Newton user and a Tandy/Casio user cannot beam information to each other, however. Future infrared attachments allow PDAs to beam information to PCs and printers as well.

REVIEW CRITERIA

To examine as wide a variety of PDA-class devices as possible, we made our criteria for an individual review any portable pen-based machine that weighed 4 pounds or less. Because some of the new PDAs were in the final stages of beta testing, we suspended our practice of only reviewing shipping products. But all units needed to have announced shipping dates of no later than Fall 1993 (and all should now be available). This filter netted eight machines—including PDAs from Amstrad, Apple, EO, and Tandy/Casio, and multipurpose pen machines from AST Research, Dauphin Technology, Fujitsu Personal Systems, and Toshiba America Information Systems.

We also gathered a representative

sampling of seven keyboard-based personal organizers for a sidebar. These included machines from Casio, Hewlett-Packard Co., Omron Office Automation Products, Psion, and Sharp. While these machines are not pen-centric, they incorporate features, functionality, and communications technology common to PDAs, making them close cousins.

Additionally, we collected almost all the available portable pen-based computers weighing more than 4 pounds for a sidebar. This group of five machines included pen-centric and hybrid systems (convertibles with keyboards and pen interfaces) from AST Research, IBM, NEC Technologies, and Zenith Data Systems. With wireless communications options and personal information management (PIM) software, these machines can function as large PDAs. Samsung Electronic America's PenMaster was not reviewed, as Samsung was in the process of upgrading the 386-based machine to a 486-based model.

Finally, we allotted a sidebar to a representative group of four specialty and vertical-application pen-based machines that are used chiefly for form-based data collection. Here we look at units from Data Entry Systems, Inforite Corp., MicroSlate, and PI Systems Corp.

Pen applications are proliferating in niche markets as different users appropriate the technology for data gathering. They are used by driver delivery services, car-rental agencies, doctors' offices, and those taking warehouse inventory. These portable vertical markets were pioneered by companies such as Norand Corp., Symbol Technologies, and Telxon Corp. Many of the systems use communications and handwriting software common to pen notebooks and PDAs.

SHARING TECHNOLOGY

As our collection of machines shows, pen-based computing is being developed along multiple lines—general-purpose

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PDAs

tablets and convertibles, specialty tablets for niche applications, and PDAs. Moreover, technology developed on each of these platforms is being leveraged across the other lines. Sharp, for example, has added a pen component to its keyboard-based Wizard and has been working with Apple to produce the Newton.

Pen-based computing and wireless communications options (fax and data modems; PCMCIA modems; and cellular, radio-frequency, and infrared transmission) are being incorporated into all types of portable devices for commercial and industrial use. Motorola is incorporating its wireless communications technology in PDA designs, while technology used in IBM's ruggedized industrial hand-held units (TouchMobile and PCRadio—a cellular mobile computer that runs DOS applications) is also being considered for PDA devices.

Machines like the Dauphin DTR-1 Desktop Replacement and Fujitsu 325Point, which are lightweight pen-based computers with detachable keyboards, can be used as general-purpose notebooks and are also custom configured by the vendor for vertical-market applications. While these machines can serve as PDAs, they lack integrated personal organization tools and PDA interfaces.

PDA PARTNERS

The PDAs we examine here, and most of the PDAs under development, are the result of strategic partnerships. Partnerships are virtually a requirement because no longer can one company develop all the hardware and software technologies required to be successful in this new market. Apple, which worked with Sharp to develop the Newton, has licensed Newton technology to Matsushita Electric Co., Motorola, and Siemens and Rolm. Tandy worked closely with Casio to develop the Tandy/Casio, and the EO is the result of a partnership between AT&T, Marubeni International Electronics Corp., and Matsushita. Each partner brings a different skill to the party (hardware, software, communications, miniaturization, manufacturing, and so on).

To miniaturize the devices, PDA designers had to rethink the components they used and throw out old ideas. They

turned to new processors and screens, and to system software capable of running on a set of pen-light batteries (with no backlighting).

The small size of PDAs has caused developers to jettison keyboards in favor of pen-based operating systems. Handwriting recognition has been incorporated for notetaking and software commands. Future devices will incorporate voice recognition, which will free users completely from reliance on touch commands.

Another component that has been eliminated from PDAs is the floppy disk drive. Users will load new applications into their PDAs by slipping a card into a PCMCIA socket. Or, by using a wire-

less link (or the more pedestrian method of attaching a cable), they can connect to their desktops to download files and synchronize their systems.

New computing platforms create a need for new processors with closely coupled operating systems, and there has been a flood of both for PDAs. The first wave of PDAs are based on non-Intel chips. The Newton uses a RISC-based processor called the ARM 610, which is made by Advanced RISC Machines in Cambridge, England. The EO uses AT&T's Hobbit processor, and devices from General Magic (a spin off of Apple) will use Motorola's Dragon.

These chips are all 32-bit, low-

Suitability to Task: PDAs and Pens

Several of the units in this roundup were preproduction models, and their capabilities may change dramatically in the coming months. One unit that was a shipping product, the AT&T EO 440 Personal Communicator, managed to do well in nearly all of our Suitability to Task categories. Its built-in cellular fax modem and standard PCMCIA Type II slot helped it achieve an *excellent* rating for communications. The growing number of PenPoint applications being written for EO's Hobbit chip will improve the unit's daytimer functionality. The EO unit, which achieved a *good* mobility rating, would have merited an *excellent* with better battery life.

The Apple Newton MessagePad's built-in cursive-handwriting engine and trainability earned the unit a *good* rating for handwriting recognition. The Newton's object-oriented development environment is robust and earned the unit another *good* rating for custom applications. The Newton received a *good* rather than an *excellent* mobility rating because of its relatively low battery life.

The Tandy Z-PDA/Casio Z-7000 Personal Digital Assistant and the Amstrad Pen Pad PDA600 earned *excellent* scores for mobility, combining low weight and good battery life. But each would benefit from a more powerful CPU and a backlit or sidelit display.

SUITABILITY TO TASK				
Product Name				
	POOR	FAIR	GOOD	EXCELLENT
Daytimer	●	○	○	○
Communications	●	●	○	○
Custom applications	●	●	●	○
Handwriting recognition	●	●	●	●
Mobility	●	●	●	●

Daytimer involves core productivity applications. These include the address book, appointment calendar, and notetaker. The availability of additional productivity software has influence here, as does the implementation of the handwriting engine and user interface.

Communications involves such factors as file transfer to and from the desktop (including printing), cellular and radio fax modem capabilities, network connectivity, and—where applicable—PCMCIA connectivity.

In evaluating **custom applications**, we focus on development support in the form of a well-defined software development kit, the ability to assimilate custom (such as form-based) software easily, and the existence of advanced development tools.

Handwriting recognition involves the handwriting engine. Our evaluation is based on subjective accuracy and feature testing, which rates flexibility and ease of use.

Mobility involves size, weight, battery life, and ruggedness.

HIGHLIGHTS

Pens and PDAs

PEN COMPUTING IS EVOLVING along several lines: PDAs, notebooks, sub-notebooks, convertibles, and vertical-market specialty tablets. Pen, hand-writing-recognition, PCMCIA, and wireless-communications technologies are being leveraged across all classes of portable devices.

WE FOCUS HERE ON PDA-class pen computers weighing 4 pounds or less. We also look at the wider world of pen computers and keyboard-based personal organizers. This story discusses four PDAs, four sub-4-pound pen computers, five pen notebooks and tablets weighing in above 4 pounds, four pen specialty tablets, and seven keyboard-based personal organizers.

AMONG THE FOUR PDAS HERE, the Amstrad Pen Pad PDA600, Apple

Newton MessagePad, and Tandy Z-PDA/Casio Z-7000 Personal Digital Assistant are similar in appearance, size, functionality, and price. The AT&T EO 440 Personal Communicator is larger, more expensive, and geared more toward communications.

KEY TECHNOLOGIES SUCH AS wireless communications, PCMCIA cards, and on-line services—which will enable PDAs to reach their full potential—are still immature or nonexistent in this area of the PC market. But based on the energy being devoted to development, the quality of PDA players, and the opportunities for start-ups, the PDA future looks promising.

THE VALUE OF THESE FIRST PDAS is relative. We believe they are suitable for corporate pilot programs and for

individuals who would be satisfied with their base-level functionality. With PCMCIA slots, these products have a growth path.

THE DAUPHIN DTR-1 DESKTOP

Replacement and Fujitsu 325Point represent a brand new breed of lightweight pen tablets with detachable keyboards. These tablets are customizable and targeted primarily at vertical markets, but they can also serve as general-purpose machines. Their main appeal is their considerable flexibility.

THE LARGER general-purpose pen machines—notebooks, convertibles, and tablets weighing in above 4 pounds—are best suited for field data gathering and are mediocre laptop replacements.

powered, low-cost devices. Not only do they have the power to drive PDA applications and handwriting engines, but they are inexpensive enough to put into a device that will sell for \$700 or less.

VSLI Technology's joint project with Intel has resulted in the development of chips called the Polar and Draco. The Polar is 386-based, while the Draco has a 486 core. Both chips will let hardware vendors design hand-held devices based on the Intel x86 architecture, which will be able to run a subset of Windows. Advanced Micro Devices reportedly is developing a similar 3-volt integrated 386-based chip for the hand-held-computer market, code-named the Elan.

To run on low-power chips, PDA operating systems have had to be written small enough to be placed into ROM, and they do not have the luxury of taking up valuable hard disk space. Apple created a new object-oriented operating system to run on Newton's ARM610 chip. Originally called NewtOS, but renamed Newton Intelligence, it resides in 4MB of

ROM and works in a mere 640K of RAM.

GO Corp.'s PenPoint (used by AST Research, EO, IBM, NEC, NCR Corp., Toshiba, and others) works on both the Intel and Hobbit chips and can fit into 8MB of ROM. A new, slimmer version (code-named the Amstel) is due sometime this fall.

Tandy and Casio departed from the

Tandy and Casio departed from the 32-bit trend and opted for a 16-bit processor for their PDA.

32-bit trend and opted for a 16-bit processor for their PDA. The unnamed processor, developed by Casio, is equivalent to (and compatible with) an Intel 8086 chip. Tandy and Casio chose GeoWorks' GEOS as the operating system because it uses a graphical user interface and performs acceptably on the inexpensive chip. GEOS also is DOS-compatible.

GeoWorks took great pains to put power-conservation features in GEOS, which enables the Tandy/Casio to oper-

ate up to 100 hours on three AA batteries. By comparison, the Newton's 32-bit processor and operating system are expected to get a maximum of 32 hours, with the average being closer to 10 hours.

PDA FRONTIER

One start-up of potential importance is General Magic, whose partners include Apple, AT&T, Matsushita, Motorola, Philips Consumer Electronics, and Sony Electronics. General Magic is developing an operating system and user interface for PDAs called Magic

Cap, and a new communications-oriented programming language called Telescript (which describes rich message formats and complex conditional routing). General Magic also is working on a hand-held communications device that will use its software. Products from General Magic's partnerships are not expected until sometime in 1994.

Motorola is developing what it calls a personal intelligent communicator (code-named Alarm Clock), which will



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The P5-60 comes standard in Gateway 2000's new, smaller tower case, taking you to new levels of expandability. It has 5 external drive bays, 6 internal drive bays and a 300-watt power supply.

For the *utmost* in performance, and the *best* investment for your future computing needs, the P5-60 is the only system for you! When it comes to being the industry's value-leader, Gateway 2000 has always been a jump ahead of the competition. Call a Gateway sales representative today for more information on the P5-60.

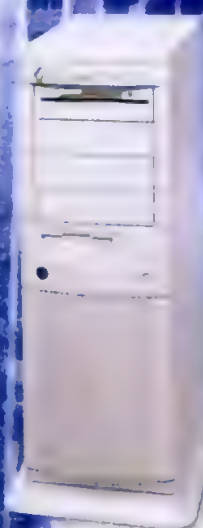
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Secondary caches unlock the full performance potential of your CPU. Gateway VESA systems come standard with 128K cache, and the award-winning DX2-66V with 256K cache.

Your Choice of Software

Only Gateway gives you a choice of top-shelf application software. VESA local bus and PCI systems include options like Microsoft® Word for Windows,™ MS Excel,™ Borland® Paradox® and Quattro® Pro for Windows, and more. Then we add Central Point's Tools on Top™ utility software, based on the award-winning PC-Tools for Windows. Systems with a CD-ROM drive include Gateway's famous

FOR THE FEWEST BUCKS

System CD containing Microsoft's Multimedia Pack,™ the Gateway Mall and much more. All software is pre-installed on your system at no extra charge.

AnyKey® Keyboard

Don't settle for a rigid 101-keyboard when you can have the flexibility of Gateway's exclusive 124-key AnyKey keyboard with programmable macros and keyboard remapping capabilities.

CD-ROM Drive

All DX2 systems come standard with a CD-ROM drive, giving you access to exciting new applications, databases and entertainment programs. All Gateway systems can be easily upgraded to include a CD-ROM.

Expandability

For those of you who still want to jazz up your PC ensemble, we're giving you all

the instruments you need for expansion. You'll get 4 external drive bays for floppies, a CD-ROM drive, tape backup, and don't forget all the medias of the future. Three internal drive bays allow you to easily add hard drive space. Two VESA slots guarantee upgradeability to tomorrow's totally cool graphics and disk controller technology; and 5 ISA slots are compatible with 16-bit technologies.

Gateway has always had a reputation for marching ahead of the crowd by giving you the *greatest* values. Our award-winning VESA systems are no exception. Call Gateway 2000 today and ask your sales representative for more information on these VESA local bus systems.

Standard with VESA systems is our new Baby AT case measuring 16.9-inches wide, 6.6-inch high and 16.8-inch deep.



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GET THE BIGGEST VALUE

The tall and short of it is: Gateway 2000 elevates value to enormous levels on our integrated mini desktop systems... but still gives you pint-sized prices. We've gone to extremes to bring you all new mini desktop configurations with colossal features and performance in a new case. Whether you need a 486SX-25 processor, a 486DX2-66 processor, or anything in-between, Gateway has the system for you. And with prices lower than ever, you get a huge value without having to pay an arm and a leg.

Big Performance/Little Prices

Check out Gateway's new 4DX2-66 mini desktop — it's a small package that packs a big punch for under \$2,000! While other companies might slash their prices, you could get the short end of the stick when it comes to features. Gateway won't short-change you on anything. You get a 66MHz 486DX2 processor, 128K cache, a 340MB hard drive, 4MB RAM and fast video performance. Our 4SX and 4DX models come standard with Microsoft Works™ for Windows; 4DX2 models come with an extended selection of application software. And all mini desktop models come standard with MS DOS® 6 and MS Windows™ 3.1. All application software comes pre-installed on the hard drive at no extra charge.

Local Bus Video

Our new integrated local bus video provides up to twice the video performance found in our previous mini desktop systems. In fact, Gateway's mini desktop video performance is similar to that found in many of our competition's high-end systems. With up to 1MB video DRAM, you get 1024 x 768 resolution and an array of colors. All this on our 14-inch CrystalScan non-interlaced, .28mm dot pitch color monitor.

Price/Performance

How can we give you all these features at such low prices? Gateway's engineers went out on a limb to design our mini desktops to include many subsystems incorporated on the motherboard. This means less cost to us, and a giant savings for you!



ON OUR SMALLEST DESKTOP SYSTEMS

Increased Expandability

You won't have any growing pains with Gateway's new integrated mini desktop cases. They're small, but you get more flexibility and expandability than ever before. These cases come with one internal and one external 3 1/2-inch drive bays, and two external 5 1/4-inch drive bays so you can add a tape backup, CD-ROM drive or another floppy drive. You also get 5 expansion slots: more than you'll find in most small footprint PCs. And all Gateway mini desktop systems are upgradeable to Pentium technology.

With the *coolest* features at miniature prices, our mini desktop systems give you an unbeatable value. Call your Gateway sales representative today for more information on these power-packed mini desktop systems.

You get greater expandability with our new mini desktop cases, measuring 16.9-inches wide, 4.4-inches high and 15.9-inches deep.

Get a Gateway...



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THE LITTLEST THINGS

A little effort and ingenuity can go a long way. At Gateway 2000, our wheels are always turning to find new ways to become more environmentally conscious. And we haven't just jumped on the "green" bandwagon. Gateway has consistently gone to extremes to reduce waste and pollution, and to increase energy efficiency. When you get your Gateway 2000 system, you can be assured that we're doing our best to make your world a better place.

Recycling and Soy Inks

Gateway has always used recycled paper whenever possible. In fact, this advertisement is printed on recycled paper, using soy ink. Recycled paper is used internally for 75% of our printed materials including newsletters, letterhead, envelopes, invoices and sales literature. Soy ink is used to print 100% of these materials.

Friendly Packaging

All Gateway systems come in boxes made from 50% recycled linerboard. Packaging inside system boxes is made from expanded polyethylene. This environmentally safe packaging contains no CFCs or HCFCs and does not produce any toxic residue when incinerated or deposited in a landfill. Gateway's packaging is recyclable by the manufacturer.

We have also eliminated any ozone-depleting chemicals at our North Sioux City, South Dakota, facility. In turn, we require our suppliers not to use CFCs on or in any parts shipped to Gateway.

On-Line Documents And CDs

Gateway's on-line documentation and System CDs also make a positive impact on the environment. Our On-Line User's Guide is fully interactive so you can learn about your Gateway PC without ever opening a manual. And the Gateway

CAN MAKE THE BIGGEST DIFFERENCE

System CD contains software applications including Microsoft's Multimedia Pack. By putting software and manuals on CD-ROM, we reduce paper waste and other environmental costs of software documentation. It's also a way to replace most of the diskettes that would normally come with your PC. CD-ROMs will eventually replace much of the paper materials and thus, save trees.

Global Releaf

Gateway is a corporate sponsor of Global Releaf, a campaign of American Forests, dedicated to the improvement of the world's environment through the preservation and planting of trees and forests. With our donations, Global Releaf planted over 15,000 trees in 1992. You can help restore damaged forest ecosystems in the United States by calling Global Releaf for more information at 202-667-3300.



Energy Star Program

The Environmental Protection Agency's Energy Star Program is fast-becoming the industry standard in the "green" movement. PCs and monitors with the Energy Star logo are capable of consuming 30 watts or less of electricity. This is right in line with Gateway's philosophy of being environmentally conscious and saving you money. And by providing a high performance computer that also consumes less energy, we're doing the right thing for our customers — and the world.

Gateway is making significant progress in our development of energy-efficient PCs with power-sensitive monitors, energy-efficient CD-ROM drives, high-efficiency power supplies and video cards, and low-power system boards.

We always search for the *newest and best* ways to conserve energy and reduce pollution, and to serve as an example of environmental consciousness for the corporate world. Call a Gateway sales representative for more information on our Energy Star-compliant PCs.



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GET THE STRONGEST SERVICE AND SUPPORT

We're committed to bending over backward to please our customers. Gateway employees understand that there may be a time when your computer makes you feel a little weak in the knees. Never fear — our Midwestern people know the importance of a friendly voice and a helpful attitude on the other end of the phone. And they know you want the best in service. So you can count on Gateway 2000 employees to perform feats of great strength to take care of you.

Be assured that we'll be there for you far into the future. Our financial stability has always held steady in the ever-changing PC industry. And although we're not letting it go to our heads, Gateway is one of the largest PC makers in the U.S. and a Fortune 500 company.

Every Gateway system comes with excellent after-the-sale support. You get a **30-day money-back guarantee**. So, if you're not completely satisfied with your system, you can send it back within 30 days for a refund.

All Gateway 2000 systems have a **one-year limited warranty** and telephone **technical support for the life of the system**. When you need help with your PC, you want someone who will jump through hoops to help you. That's what you'll get with our support departments. In February and again in July of 1993, *PC Magazine* readers gave Gateway an excellent rating for service and reliability. And in June, *BYTE* readers chose Gateway 2000 as the company that provides the best service in the industry.

Gateway's **automated fax service** will supply you with detailed documentation on over 150 technical subjects. You'll also get a **lifetime BBS membership** for additional technical support and on-line forums.

We offer **on-site service** to most locations in the country (factory service only for notebooks). And **replacement parts** leave our factory as quickly as possible; we pay overnight shipping.

We also make it easy for you to buy a Gateway PC, with **convenient payment options** including major credit cards and C.O.D. terms. Net 30-day term and leasing options are also available to qualified commercial customers.

Introducing The Gateway DuoLine MasterCard® Card

Here's another value-added way to get the latest technology: the Gateway 2000 DuoLine MasterCard now available only through Gateway 2000.

This innovative card enables you to make purchases from Gateway and anywhere else MasterCard is accepted, by giving you two lines of credit — one for Gateway purchases and one for all other purchases. For Gateway purchases, the card has no annual fee and a low variable interest rate of just 12.9% APR. For purchases elsewhere, you get a variable interest rate of 13.9% APR and a low \$18 annual fee.* If you already have a MasterCard, you may also apply for a Gateway DuoLine MasterCard. Lines of credit will vary by individual. For an application, call 1-800-846-1781.

*Cash advance fee is \$1 plus 2% of the amount of the cash advance, but not less than \$5 nor more than \$10. The Gateway 2000 DuoLine MasterCard is issued by Dial National Bank.



FOR YOUR WEAKEST MOMENTS

At Gateway 2000, we strive to be extremists when it comes to bringing you the **highest**-performance systems, with the **most** features at the **lowest** prices...for the **greatest** value in the PC industry. We are committed to giving you the **strongest** after-the-sale support. And we will continue to find the "**greenest**" ways to increase energy efficiency and protect the environment. Call your Gateway 2000 sales representative today!



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Gateway...

GATEWAY 2000'S COOLEST PCS

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- Intel® 25MHz 486SX Processor
- 4MB RAM
- 3.5" Diskette Drive
- 170MB 13ms IDE Hard Drive
- Intel Pentium™ Technology Ready
- Local Bus Graphics Accelerator w/ 512KB DRAM
- 14" Color CrystalScan® 1024NI
- New Mini Desktop Case
- 5 16-Bit ISA Slots
- 124-Key AnyKey® Keyboard
- Microsoft® Mouse
- MS-DOS, Windows™ & Tools
- MS Works for Windows™ 2.0

\$1295

4SX-33

- Intel 33MHz 486SX Processor
- 4MB RAM
- 3.5" Diskette Drive
- 212MB 13ms IDE Hard Drive
- Intel Pentium Technology Ready
- Local Bus Graphics Accelerator w/ 1MB DRAM
- 14" Color CrystalScan 1024NI
- New Mini Desktop Case
- 5 16-Bit ISA Slots
- 124-Key AnyKey Keyboard
- Microsoft Mouse
- MS-DOS, Windows & Tools
- MS Works for Windows 2.0

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4DX-33

- Intel 33MHz 486DX Processor
- 4MB RAM, 128KB Cache
- 3.5" Diskette Drive
- 212MB 13ms IDE Hard Drive
- Intel Pentium Technology Ready
- Local Bus Graphics Accelerator w/ 1MB DRAM
- 14" Color CrystalScan 1024NI
- New Mini Desktop Case
- 5 16-Bit ISA Slots
- 124-Key AnyKey Keyboard
- Microsoft Mouse
- MS-DOS, Windows & Tools
- MS Works for Windows 2.0

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- New Mini Desktop Case
- 5 16-Bit ISA Slots
- 124-Key AnyKey Keyboard
- Microsoft Mouse
- MS-DOS, Windows & Tools
- Choice of Application Software

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4DX2-66

- Intel 66MHz 486DX2 Processor
- 4MB RAM, 128KB Cache
- 3.5" Diskette Drive
- 340MB 13ms IDE Hard Drive
- Intel Pentium Technology Ready
- Local Bus Graphics Accelerator w/ 1MB DRAM
- 14" Color CrystalScan 1024NI
- New Mini Desktop Case
- 5 16-Bit ISA Slots
- 124-Key AnyKey Keyboard
- Microsoft Mouse
- MS-DOS, Windows & Tools
- Choice of Application Software

\$1995

4DX-33V

- Intel 33MHz 486DX Processor
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- 340MB 13ms IDE Hard Drive
- Local Bus IDE Interface
- Intel Pentium Technology Ready
- VLB Graphics Accelerator w/ 1MB DRAM
- 14" Color CrystalScan 1024NI
- New Baby AT Case
- 5 ISA & 2 VESA/ISA Slots
- 124-Key AnyKey Keyboard
- Microsoft Mouse
- MS-DOS, Windows & Tools
- Choice of Application Software

\$1995

4DX2-50V

- Intel 50MHz 486DX2 Processor
- 8MB RAM, 128KB Cache
- 3.5" Diskette Drive & CD-ROM
- 340MB 13ms IDE Hard Drive
- Local Bus IDE Interface
- Intel Pentium Technology Ready
- VLB ATI Ultra XLR Graphics w/ 1MB VRAM
- 15" Color CrystalScan 1572FS
- New Baby AT Case
- 5 ISA & 2 VESA/ISA Slots
- 124-Key AnyKey Keyboard
- Microsoft Mouse
- MS-DOS, Windows & Tools
- Choice of Application Software

\$2295

66MHz Best Buy

- Intel 66MHz 486DX2 Processor
- 8MB RAM, 128KB Cache
- 3.5" Diskette Drive & CD-ROM
- 340MB 13ms IDE Hard Drive
- Local Bus IDE Interface
- Intel Pentium Technology Ready
- VLB Graphics Accelerator w/ 1MB DRAM
- 15" Color CrystalScan 1572FS
- New Baby AT Case
- 5 ISA & 2 VESA/ISA Slots
- 124-Key AnyKey Keyboard
- Microsoft Mouse
- MS-DOS, Windows & Tools
- Choice of Application Software

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4DX2-66V

- Intel 66MHz 486DX2 Processor
- 16MB RAM, 256KB Cache
- 3.5" Diskette Drive & 2X CD-ROM
- 424MB 13ms IDE Hard Drive
- Local Bus IDE Interface
- Intel Pentium Technology Ready
- VLB ATI™ Ultra XLR Graphics w/ 1MB VRAM
- 15" Color CrystalScan 1572FS
- New Baby AT Case
- 5 ISA & 2 VESA/ISA Slots
- 124-Key AnyKey Keyboard
- Microsoft Mouse
- MS-DOS, Windows & Tools
- Choice of Application Software

\$2995

P5-60

- Intel 60MHz Pentium™ Processor
- 16MB RAM, 256KB WriteBack Cache
- 3.5" Diskette Drive & 2X CD-ROM
- 424MB 13ms IDE Hard Drive
- PCI ATI Ultra XLR 2MB Graphics
- 15" Color CrystalScan 1572FS
- New 300W Tower Case
- 4 ISA, 2 PCI & 1 PCI/ISA Slots
- 124-Key AnyKey Keyboard
- Microsoft Mouse
- MS-DOS, Windows & Tools
- Choice of Application Software

\$3595

NOMAD 450DXC

- 50MHz 486DX2 Intel Processor
- 8MB RAM
- 3.5" Diskette Drive
- 200MB IDE Hard Drive
- 8.4" Color Active Matrix Screen
- Simultaneous Video with 1MB
- Size 8.5" x 11" x 2.2", 6.2 Lbs.
- NiCad Battery & AC Pack
- 1 Parallel / 1 Serial Port
- 79-Key Keyboard & MS Ballpoint
- MS-DOS, Windows & Works for Windows

\$3995

Software Choices

If a system comes with "choice of application software," choose one of the following packages:

- Microsoft Excel for Windows™
- Microsoft Word for Windows™
- Microsoft Word and Bookshelf®92, CD-ROM Edition
- Microsoft PowerPoint for Windows™
- Microsoft Project for Windows™
- The MS Entrepreneur Pack(Works, Publisher, Money, and games)
- Borland Paradox™ and Quattro®Pro for Windows

Due to the volatility of the DRAM market, all prices are subject to change. Details about our warranty, guarantee and on-site service program are available upon request.



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AND THE HOTTEST

SOFTWARE & PERIPHERALS

SOFTWARE

Microsoft Office™ — You can upgrade from a choice of application software to Microsoft Office, CD-ROM version, for only **\$99!** This single package has all the leading Windows applications: Word, Excel and PowerPoint. The diskette edition of MS Office is also available as an upgrade from a choice of application software for **\$175**, or **\$499** as a second application.

Choice of Application Software —

If the system you want comes with MS Works for Windows, you can upgrade to a choice of application software for only **\$100**.

PERIPHERALS

■ Multimedia Upgrade Kit

Everything you need to add multimedia to your PC is included in this specially priced kit! You get:

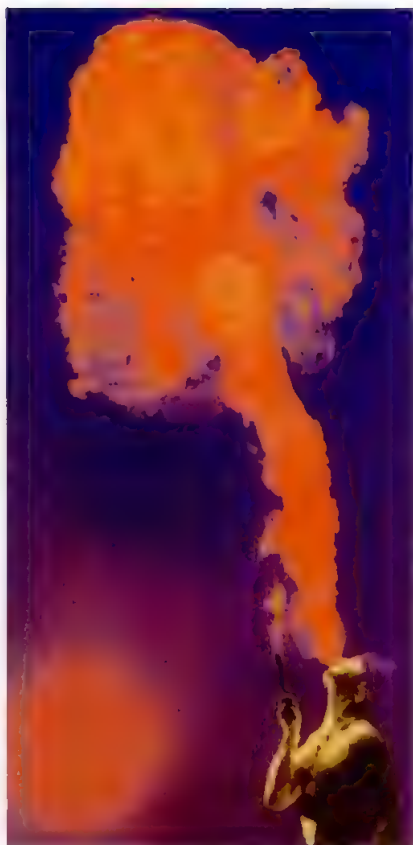
Sound Blaster™ 16 Sound Card with Advanced Signal Processing. Simply the best sound card available! This 16-bit PC audio card offers CD-quality sound, Yamaha® FM music synthesizer, MPU-401 MIDI interface, joystick connector, built-in CD-ROM interface, and more. The Advanced Signal Processing chip delivers 4:1 real-time hardware data compression while reducing CPU demands by up to 65%. Provides 100% compatibility with all Sound Blaster applications, plus DOS and Windows sound support. You also get two Labtec® speakers that attach to your PC monitor.

CD-ROM Drive. Kit comes with the same high-quality drive that we offer in our top-of-the-line 4DX2-66V system. You also get our free system CD with Microsoft Multimedia Pack™ and more!

Kit Price (with system purchase): \$395

■ Sound Kit

Get just the Sound Blaster 16 Advanced Signal Processing sound card and two Labtec CS-180 speakers. **\$195**



■ TelePath™ Fax/Modem

Internal fax/modem, 14,400bps modem, V.32bis, with 9,600bps fax capability. Package includes data communication software plus a free CompuServe® trial membership. **\$195**

■ Network Cards

Call for a selection of Ethernet cards and Token Ring adapters, installed and configured.

■ Microsoft Windows™ for Workgroups

Networking made easy! Share files and printers, send electronic mail, schedule group meetings with the click of your mouse — and get everything you need in one inexpensive package. Price includes an Ethernet adapter and software. Hardware and software are factory-installed. **\$159**

■ Colorado Memory Systems™ TBU

250MB internal automatic tape backup unit copies up to 9.5MB per minute with high-speed data compression. Comes with easy-to-use DOS software, one tape and cable. **\$175**

■ CrystalScan®

15-Inch & 17-Inch Monitors

Non-interlaced, .28 dot pitch color monitors. If your system comes with a 14-inch monitor, you can upgrade to the 15-inch model for **\$100**, or the 17-inch for **\$600**. If your system comes with a 15-inch monitor, you can upgrade to the 17-inch monitor for **\$520**. (Prices good only for upgrades at the time of system purchase.)

■ Panasonic® KX-P2123

Color-Capable Printer

Add color to your documents with this 24-pin dot matrix printer. Includes Adobe Type Manager®. Call for price!

■ Epson® Stylus™ 800 Ink Jet Printer

Great laser quality at an even greater value. Measuring only 17 inches by 10.5 inches, the Stylus 800 has 7 different typefaces and prints an extra-quiet 150 characters per second at 360 d.p.i. Parallel cable included.

Gateway 2000 Price	\$339
Epson Mail-in Rebate*	-\$50
After Rebate Cost	\$289

*Your mail-in rebate will be delivered with your Epson printer. This special price is only good for orders taken through October 31, 1993.

Call and ask about our full-line of ink jet and laser printers.

The software and peripherals listed here are sold only with the purchase of a system. For details on our complete line of extras for Gateway customers, ask for our special add-on components division when you call.

We offer many other system options and upgrades. Call today!

SERVICE

Every Gateway 2000 system is backed by:

- 30-Day Money-Back Guarantee
- One-Year Limited Warranty
- Lifetime Toll-Free Technical Support
- On-Site Service Available to Most Locations
- Lifetime BBS Membership
- FaxBack™ Automated Fax Service



Tools on Top™ is now included on all Gateway 2000 mini desktop, desktop and tower systems. Program includes file manager, desktop and emergency disk portions of Central Point's award-winning PC Tools for Windows.



have built-in two-way wireless capabilities. It will be based on Motorola's Dragon chip and will run General Magic's Magic Cap software.

Notably absent from General Magic's list of allies are Compaq Computer Corp., IBM, Intel Corp., and Microsoft Corp. Intel and Microsoft have allied to develop a new PDA operating system and chip set called WinPad, while Compaq has announced plans to develop a PDA platform called Mobile Companion, which will be based on WinPad technology. The WinPad operating system is being designed to fit in 1MB of ROM and run on the low-power (3.3-volt) integrated 386- and 486-based processors being developed by Intel and VLSI.

Compaq plans to incorporate Microsoft Windows at Work software in its Mobile Companions to enable them to communicate with PCs running Windows and office products such as fax machines, copiers, and printers. IBM reportedly is developing a DOS and OS/2 derivative to run on WinPad hardware.

IBM, which has a number of PDA prototypes in the works, is waiting to see how the market develops before committing to a particular PDA technology. While IBM wouldn't talk about specific products, it did confirm that it was developing hand-held devices that will weigh less than 1.5 pounds. IBM contends that compelling communications-based applications will drive the PDA market.

At 1992 Fall Comdex, IBM showed a portable cellular phone with a small touchpad screen. It used a pen interface to access applications. While IBM expects to field-test a number of PDAs with different designs and applications this year, its first commercial product is not expected until 1994.

Microsoft has also been developing a Windows-based PDA operating system called Mobile Windows. Microsoft gained experience putting Windows in ROM when it worked with Hewlett-Packard on the OmniBook. (For more information in this area, see the sidebar "Keyboard Based Organizers.") Mobile Windows goes even deeper. Using a subset of Windows, it can operate on a small hand-held device by being stored in 4MB of ROM. It will support PCMCIA cards

and wireless devices that connect to a LAN. Microsoft stripped out the DOS backbone and will use small Visual Basic applications, or "applets." The first planned applets are a PIM, a faxing utility, and a tool that lets you synchronize files with your desktop PC.

Some of the other probable entrants into the PDA market are Fujitsu, Matsushita, NEC, Samsung, Sony, and Toshiba. Sharp introduced its version of the Newton, which it is calling the Expert Pad, after our testing was completed. It

differs from the Newton machine only in its packaging.

WAITING FOR WIRELESS

A key piece of the PDA puzzle is wireless communications, which should open new vistas in personal computing by letting PDA users transmit and receive data (text, video, sound, fax), send dispatches, access databases and services, and perform transactions via radio modems.

Many development efforts and deals are underway to advance wireless tech-



EDITORS' CHOICE

• No Editors' Choice (Because of Product Immaturity)

The four PDAs we reviewed—the Amstrad Pen Pad PDA600, Apple Newton MessagePad, AT&T EO 440 Personal Communicator, and Tandy Z-PDA/Casio Z-7000 Personal Digital Assistant—are still too immature to warrant Editors' Choice

recommendations. Moreover, the PCMCIA technology and most of the services, applications, and wireless communications that will let these products realize their true potential are not yet available.

Our reviewers found that pen input, search, and filing operations generally were not fluid enough. Navigating and performing operations such as fax and e-mail were often difficult, and handwriting recognition was spotty.

But the Newton and EO deserve honorable mention because of their innovative design and functionality. The Newton's packaging, interface, organizer intelligence, cursive-handwriting recognition, shape interpreter, and communications capabilities make it a compelling new product. The EO provides a powerful set of cellular-phone and phone-line communications capabilities (voice, e-mail, and fax) via a pen interface and will accept PCMCIA wireless modems once they become available.

The Newton and EO are different types of machines. The Newton is more of a general-purpose PDA, suit-

able for commercial or personal use, while the EO's niche is primarily in corporate vertical-market applications. The EO is not as light and easy to carry as the Newton. It has larger memory and faster modems but is also three times as expensive.

All four PDAs deserve applause. As initial products in a new category, each is impressive and engaging. The Tandy/Casio is a nicely designed unit with a host of entertaining and useful applications and features. Though it lacks the Newton's finesse, speed, and assist features, we believe it merits consideration and will enjoy market success. The Pen Pad, while functionally less sophisticated than the EO, Newton, and Tandy/Casio, is also a well-designed and endearing device.

The other four sub-4-pound pen machines tested—the Dauphin DTR-1 Desktop Replacement, Fujitsu 325Point, GRiD PalmPAD, and Toshiba T100X Dynapad 100—clearly are not PDAs; nor are they satisfactory notebook replacements. They are best suited for custom vertical-market data-gathering applications.



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The HP 100LX palmtop PC keeps you in touch wherever you go.

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Today's new card modems fit neatly into our PCMCIA 2.0 slot, connecting you to your corporate or office e-mail systems. Talk about portable communications! This e-mail solution fits right in your pocket.



Take most of your office with you. Built-in MS-DOS® 5.0 means you can run optional PC soft-

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For more information and the name of your nearest HP 100LX dealer, call us at 1-800-443-1254, Dept. 896. Then hit the road armed with all the right answers.



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nology. A wireless infrastructure is being established by radio-frequency, cellular-phone, and paging-service ventures like Ardis, EMBARC (Electronic Mail Broadcast to a Roaming Computer), RAM Mobile Data, McCaw Cellular Communications, PacTel, and SkyTel.

Motorola's Iridium project with IBM aims to establish a global wireless network using 66 satellites. Motorola has also formed a wireless and paging division to develop PDA wireless communications systems.

One of the most significant developments for PDA communications will be the availability of wireless PCMCIA modems, with Ericsson GE Mobile Communications and the Motorola poised to become major players. (For an in-depth discussion of wireless technology, see "Connecting Over the Airwaves," *PC Magazine*, August, 1993.)

PEN PENDULUM

Over the past three years, market research firms have predicted that

PDAs and the pen-based computing market would bring computing to the keyboard-phobic masses. They foresaw buyers embracing pen technology in a number of hand-held devices for taking notes and sending e-mail and faxes. Then reality set in. The much ballyhooed pen computing never took off, and the failure of Momenta Corp., one of the first pen computer vendors, was one of the most glaring disappointments.

A year ago, we looked at the first pen-based notebook computers and found them clunky and functionally limited (see "Pen PCs" in our issue of November 10, 1992). While the hardware and operating systems have somewhat improved, handwriting recognition is still slow and faulty, and applications are few. For general-purpose computing, the performance of the machines is mediocre at best and maddeningly frustrating at worst.

But circumstances are changing, and the technologies required to make PDAs and pen computers viable are emerging. The implementation of faster processors will aid the performance of pen operating systems and handwriting-recognition engines, as will new software versions and

recognition algorithms.

Despite its many shortcomings as an input device (you'd never write a book or even a long letter with current pen computers because the handwriting recognition software is still too primitive), the pen is ideally suited for navigating through information and for drawing. Using a pen to manipulate check boxes or pick lists from a small screen is more efficient than making selections with a keyboard or mouse. Your notes can even be stored as unconverted digital ink because usually you will be the only one who needs to read them.

Pen operating systems are steadily establishing themselves as standards (see the sidebar "Pen Operating Systems" for more information). GO's PenPoint, Microsoft Windows for Pen Computing,

Circumstances are changing, and the technologies required to make PDAs and pen computers viable are emerging.

and Communication Intelligence Corp.'s PenDOS are available on a variety of pen platforms; in many of the pen machines we tested, all three were offered as options.

PDAs bring a new twist to the pen OS picture. Although the EO uses PenPoint, PDAs like the Amstrad, Newton, and Tandy/Casio use new operating systems that will most likely remain proprietary on those platforms. Microsoft's WinPad and General Magic's Magic Cap could become common across several of its licensees' products, which would further splinter the market.

A bevy of new third-party software products is being introduced that will enhance pen computing and make it more productive. Also, file-format standards that address the characteristics of electronic ink and pen computing (writing pressure, direction, speed, angle, sampling rate, and color) are being defined to establish ink as a data type.

KEYS TO SUCCESS

A new hardware platform's success has always been dependent on the applications that run on it, and PDAs and pen

computers are no exception. Although PDAs are targeted at mobile workers and road warriors who demand instant information, fax, or e-mail, the brass ring many companies are hoping to grab is the broad consumer electronics market. To reach that mass market, PDA vendors are lining up content providers and information services to supply valuable applications for their devices.

AT&T is beefing up its EasyLink Services for both the PenPoint and Telescript platforms, while Mead Data Central and News Corp. plan to offer new information services on the General Magic platform. Apple is developing Newton Mail, with links to America Online, AppleLink, Internet, and CompuServe, while Motorola is busily perfecting wireless modems, as well as its PCMCIA-

based MessageCard for two-way paging. Palm Computing, the company that developed the handwriting recognition and applications that ship with the Tandy/Casio, is also currently

working on new offerings.

Intuit, whose Pocket Quicken is already on the Tandy/Casio, is working on a Quicken version for the General Magic platform. And although Microsoft's and Compaq's entry into the PDA field won't be unveiled until 1994, we expect Microsoft to prerelease a software development kit that will make certain that a number of applications and services will be ready when the unit does ship. GeoWorks provides a software development kit for independent software vendors to develop applications for the Tandy/Casio.

On the PenPoint platform, a number of compelling applications are finally hitting the market. Most interesting are Aha! Software Corp.'s Ink Writer and Ink Development Corp.'s InkWare NoteTaker, both of which let you cut and paste electronic handwritten documents. Notable Technologies' Mobile Access communications software lets PenPoint users access on-line services. In addition, vertical development tools like MagicScript—the visual scripting system in PenMagic Software's Numero 2.0—and Slate Corp.'s PenApps Application

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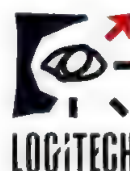
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Builder make it easier for companies to create custom applications for PenPoint. All these PenPoint applications will be available for the EO.

PENS IN PROGRESS

Despite the lack of demand for pen-based systems, most large computer companies have tested the waters with some type of pen-based system. Among the missing PC vendors in the pen arena are Dell Computer Corp. and Gateway 2000. Compaq recently entered the fray with a 6.5-pound, 486-based pen convertible notebook with a detachable keyboard, called the Concerto, which was not available for our review.

IBM, which has introduced the IBM ThinkPad 710T (see the sidebar "Mainstream Pen-Based Portable PCs" for more details), also has plans to introduce a convertible notebook toward the end of this year. Hewlett-Packard, which has had huge success with its HP 95LX and HP 100LX keyboard-based organizers, is monitoring the market and quietly experimenting with pen solutions. Apple reportedly has shelved its plans to release a pen-based PowerBook.

Another means to pen computing is via add-on devices that attach to a PC or notebook through a serial port. Solutions include Arthur Dent Associates' Write-Away, Communication Intelligence Corp.'s Handwriter, Inforite's Writing Pad MP100, and Mouse Systems Corp.'s PenMate. Some of these come with Microsoft's Pen Extensions, which are added into Windows. (Microsoft plans to bundle Pen Extensions into a future version of Windows.) Handwriter comes with CIC's PenDOS operating system and handwriting-recognition engine. PenDirect from FTG Data Systems uses a light pen that interacts directly with a VGA display and can double as a mouse.

TEST RESULTS

Because each of the PDAs tested uses a different processor and operating system (as well as different applications, handwriting-recognition engines, and functions), we could not conduct rigid performance tests like those we use for PCs and

laptops. Moreover, several of the machines were beta units and would not have yielded results that could be fairly ascribed to the final production models.

But we put together a suite of five PDA-oriented Suitability to Task criteria by which to measure and compare machine functionality. Task categories were daytimer, communications, custom applications, handwriting recognition, and mobility.

The relative strengths and weaknesses of the different PDAs are reflected in these scores. The EO, which is primarily geared toward communications (*Personal Communicator* is a part of its name), garnered the best score on our communications tasks and very good overall results. The Newton, which also had very good overall results, had the

Despite lack of demand, most large computer companies have tested the waters with some type of pen system.

best handwriting recognition, thanks to Apple's proprietary cursive technology. The Pen Pad and Tandy/Casio had the highest scores on our mobility tasks. These two products also had decent overall scores. Each of the PDAs appeared to have fair-to-good custom application-development capabilities (and software development kits). But the beta machines could not be used for development, and software development kits were not yet ready for some. Moreover, there are few, if any, applications available by which to measure any of the PDAs.

The sub-4-pound non-PDAs (the Dauphin, Toshiba T100X Dynapad, GRiD PalmPAD, and 325Point) generally did not fare well on the more PDA-specific tasks—daytimer and handwriting recognition—because they lack integrated personal organizer tools and rely on the mediocre handwriting-recognition engines in their operating systems, Pen Windows and PenPoint.

We looked at these four small lightweight pen-based computers (which had no built-in keyboards) to see how they might serve as PDA substitutes and notebook or subnotebook replacements.

Generally, we found that their size, cost, and lack of PIM tools made them inadequate PDA substitutes. And we found them too finicky and functionally limited to be notebook substitutes. The machines occupy a gray area between vertical-oriented and general-purpose use. As our reviewers found, this dichotomy makes them only middling performers in each area, but attractive nevertheless for their flexibility.

PDA PERSPECTIVE

This first group of PDAs both excited and disappointed our reviewers. The little machines are so alluring you want them to succeed. And, on many levels, they do. Compared with the first PCs (the \$397 Altair kits in 1975, for which there were no monitors, operating systems, or applications software), these first PDAs are impressive devices.

For example, a fully configured EO lets you pen compute, send and receive faxes and e-mail, voice annotate, and make cellular phone calls right out of the box. The Pen Pad, Newton, and Tandy/Casio—with handwriting recognition and nifty icon-based applets—are chock-full of entertaining and useful functions.

Though all our reviewers expressed an initial sense of awe and delight, these reactions inevitably gave way to frustration as they became more familiar with the machines. Handwriting recognition was slow and inaccurate. Some applications were marginally useful or gimmicky. Machines and applications were clunky and difficult to use. Screens were hard to read. Pens were small. Communications options and peripherals were absent.

Because of a paucity of applications and the immaturity of wireless communications, PCMCIA technology, and handwriting and voice recognition, PDAs can not yet fulfill their potential. But the potential is real, and the technology will advance rapidly over the next few years. Refinement will yield more-powerful processors, recognition algorithms, and applications. Cost constraints will be overcome (through innovation and economy of scale) to provide better screens and accessories.

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Meanwhile, these first PDAs offer a reasonable amount of usefulness, along with a flexible foundation on which to add capabilities. Whether the functionality these products provide is compelling enough for you to buy one is a simply a matter of personal taste. (Gadgeteers will find them irresistible, while companies may deem them adequate for pilot programs.) A lot of serious development is underway, and based on these initial products, the PDA future looks quite promising.

Amstrad

Amstrad Pen Pad PDA600

BY JEFF GREENBERG

Although the Amstrad Pen Pad PDA600 was the first pocket-size PDA to ship (March 1993), it is currently available only in England and is expected to sell for about \$399 in the U.S. The machine is similar in concept to the better-known Apple Newton MessagePad and Tandy Z-PDA/Casio Z-7000 Personal Digital Assistant, and while Amstrad deserves credit for being first to market with a decent product, the Pen Pad is not a paragon of PDA prowess.

The first thing you notice about the Pen Pad is its small size. It's just 6.25 by 4.5 by 1 inches (HWD) and weighs only .88 pounds. It easily fits in a coat pocket and is as close to being comfortably portable as any available computer.

The Pen Pad's screen measures 2.88 by 3.62 inches with a 240-by-320 resolution, and is protected by a hinged cover that opens to the left (which makes the Pen Pad a little more difficult to use for left-handers). The screen is reflective and has a low contrast ratio, making it difficult to read in dim light.

SUITABILITY TO TASK				
Amstrad Pen Pad PDA600				
	POOR	FAIR	GOOD	EXCELLENT
Daytimer	●	●	●	○
Communications	●	●	○	○
Custom applications	●	●	○	○
Handwriting recognition	●	●	○	○
Mobility	●	●	●	●

The Pen Pad is powered by a 20-MHz Zilog Z8S180 (roughly equivalent to a 16-MHz Intel 286), and runs for 40 hours on three AA batteries. The standard configuration includes 128K of memory that can be upgraded to 2MB using a PCMCIA expansion slot. This slot can also be used for software cards, although there were none available to test. Standard equipment also includes a proprietary mini-serial port. An RS-232 converter cable is optional.

The Pen Pad generally has good ergonomics and industrial design. Along the top and side of the screen are icons that are tapped to switch applications, turn pages, and configure the system. A plastic stylus conveniently clips into a slot on the back of the computer.

The Pen Pad comes with five main applications: phone book, calendar, to-do list, notepad, and a measurement-conversion tool. Each application is started by tapping the corresponding icon along the left edge of the screen.

Unfortunately, the overall usefulness of the Pen Pad does not measure up to its physical design. A key limitation is its software. Most entries are restricted to 18 or 21 characters, and the lack of cutting, copying, and pasting functions makes it impossible to duplicate all or part of a record. This makes the Pen Pad somewhat tedious to use.

The Pen Pad's phone book lacks sophisticated search capabilities. Entries are sorted by the first character in the name field, whether that character is part of a first name, last name, or title.

All text entry is performed through a common pop-up dialog window. Each character must be written in a separate box within this dialog window. There is no way to add or delete characters in the middle of an entry, and you must backspace to your error to add or remove a character.

One of the options in the text-entry window is a training screen, which allows

you to write a selected character four times. Once you have trained a character, its recognition rate improves to a significant degree.

The electronic phone book supports two views. In the condensed view, you see the name and first telephone number of each record in your phone book database. In the expanded view, each entry takes up the entire screen and contains



The Amstrad Pen Pad PDA600 is a full-fledged PDA with trainable handwriting recognition.

the following: two lines for each name, five lines for the address, and room for up to four telephone numbers and seven lines of notes. Users can designate phone numbers with preset labels—home, office, mobile, or fax—or create their own labels.

The Penpad's calendar provides at-a-glance views of days and weeks. In the day view, the top half of the screen displays scheduled appointments and to-do items. You can use the bottom half of the screen for notes or drawings.

A separate to-do application lets you create and track personal action items, which are displayed in chronological order. An indicator in the calendar application tells you that you have to-do items for a given day, but you have to click on the indicator and jump to the to-do application to read them.

The notepad application lets you create and save drawings. All notes are stored as ink; the handwriting in this application is not processed by the recognizer. The conversion tool application contains 27 categories (for example, miles to kilometers) as well as space for you to add nine conversion categories of your own.

Besides the core applications, the Pen Pad also has a number of utilities. Icons along the top border can be tapped to adjust the contrast, start a calculator program, erase all or part of an entry, and move forward or back a page. A desktop utility lets you set the clock/calendar, enter anniversary dates, and monitor and configure the hardware.

The Pen Pad stakes out the low-end

▪ Mainstream Pen-Based Portables

by Don Crabb

Besides PDAs and vertical-market slates, there are a bunch of other pen-based computers that weigh more than 4 pounds and purport to offer the state of the art in mobile pen-based computing.

These more mainstream machines are not cheap. The units we tested, the GRiD Convertible 486, GRiDPADsl, IBM ThinkPad 710T, NEC VersaPad, and ZDS Z-Notepad 425Ln, cost anywhere from \$450 to \$1,100 more than equivalently equipped notebook machines. Each of these machines is DOS-based and uses either Microsoft Windows for Pen Computing, PenDOS, PenPoint, or PenRight! You can also expect to find at least a 386 CPU, a hard disk, PCMCIA slots, and a decent amount of RAM.

SORTING OUT THE MAINSTREAM

If you're a person who isn't tied to a chair and keyboard, and if you need a portable PC to work in unusual or adverse environments, a pen-based computer with a good pen interface may be right for you, especially if it has been equipped with enough RAM, storage, and communications options. Pen-based PCs like those reviewed here are particularly suited for gathering information from remote sites.

The Convertible, VersaPad, and Z-Notepad can each function as a pen tablet and a keyboard-driven notebook. Each would make a good choice if you needed to use the pen interface in the field—and you could still get real work done if the pen proved to be a bust.

The ThinkPad has good handwriting recognition and functions smoothly when pen driven. During testing, we found that the ThinkPad, along with the VersaPad, functioned as a pen computer better than any of the other units in this group.

The GRiDPADsl was the only pure pen-based machine here, but using its

stylus was troublesome, and no matter what interface we tried, we often had to double and triple tap the slate to get a command to execute.

ZDS Z-NOTEPAD 425LN

Our testing showed the 6.6-pound Z-Notepad to be a sturdy, well-made machine that should provide good service over the long haul. At 2.2 by 11.9 by 8.5 inches, though, you'll find it difficult to balance on your lap for pen work.

The Z-Notepad, built around a 25-MHz 486SL CPU, offers performance that is on a par with the other fast machine in this group, the VersaPad. Our test unit came with 4MB of RAM, which can be expanded to 28MB, and a 120MB IDE hard disk. Its operating systems were DOS and Pen Windows.

Battery life was very good, averaging nearly 4 hours. That makes the Z-Notepad a good choice for environments in which keeping batteries charged would be difficult. Batteries also quickly recharged (about 1 hour with the machine turned off).

You may configure the Z-Notepad with either a 2,400-bps data/9,600-bps fax modem or a 14.4-Kbps data/fax modem. There are no wireless communication options, and the machine lacks a PCMCIA slot.

Despite mediocre pen control and handwriting recognition, the Z-Notepad is a decent machine and a worthwhile investment if you want to get into pen computing without having to sacrifice the prowess of a keyboard-driven notebook. You should be prepared to spend at least \$2,999.

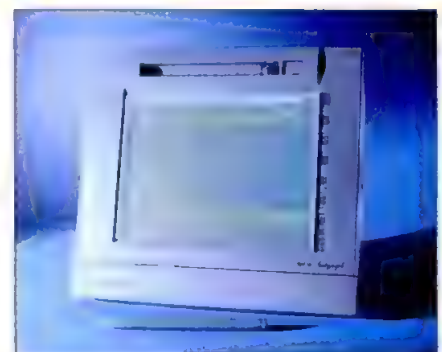
NEC VERSAPAD

The slick-looking 3.9-pound VersaPad was one of the most powerful computers in this group. Using Intel's 3.3-volt 20-MHz 486SL, the VersaPad comes with Pen Windows or PenDOS (\$2,999), PenPoint (\$3,099), or PenRight! (\$3,149). The unit that we tested used the Win-

dows package and came with 4MB of RAM (expandable to 12MB), a 40MB hard disk, a built-in 720K/1.44MB floppy disk drive, and two PCMCIA Type II sockets.

A svelte 10.9 by 9.8 by 1.2 inches, the VersaPad was more manageable than the Z-Notepad. To help tackle the pen problem of slow video response, it includes NEC's implementation of the Peripheral Interface bus in the 486SL, an industry first for such machines.

The VersaPad has an active CalComp digitizer, an untethered stylus,

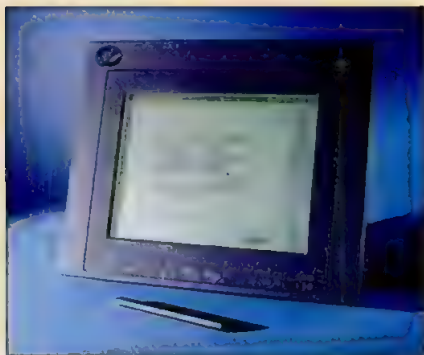


and a 9.4-inch (diagonal) VGA screen. As you would expect from Pen Windows, programmable icons along the panel edge can trigger common tasks or programs.

The VersaPad did very well during testing, turning in above-average handwriting-recognition scores that were similar to the ThinkPad's. The VersaPad was our top pick of this group.

GRID CONVERTIBLE 486

The \$2,995 6-pound Convertible looks like a pen tablet until you raise and rotate the screen to reveal the keyboard underneath; then it's a pentop. Aided by a 25-MHz 486SL CPU, the Convertible zipped along pretty well. It came with



The five pen-based computers that we cover here are either dedicated pen machines or keyboard-based convertible machines. Unlike vertical-market systems, these pen-based computers are generally geared toward providing a pen-based interface for mainstream applications. The pen can serve as a mouse and can augment or replace the keyboard for data input. Ink notes can be taken, and handwriting is recognized. Clockwise from bottom left: the NEC VersaPad, GRiDPADsl, GRID Convertible 486, ZDS Z-Notepad 425Ln, and IBM ThinkPad 710T.

4MB of RAM (expandable to 20MB), a 200MB hard disk, a PCMCIA Type II slot, and an external 3.5-inch 720K/1.44MB floppy disk. Altogether, it's a pretty solid hardware platform for the price.

Although the Convertible is nearly as hefty as the Z-Notepad, its battery lasted only about half as long as the ZDS product's, making it a potentially more problematic performer in mobile situations. Using the Convertible with Pen Windows was not what we would call an enjoyable testing experience. The response could best be described as clunky and not one we would want to endure every day.

IBM THINKPAD 710T

A subnotebook with pen capability, the ThinkPad both surprised and pleased us during testing because of its good pen control and pen usage response. The ThinkPad is powered by IBM's 486SLC/25 CPU, which gives this subnotebook sufficient horsepower to handle pen work. Unfortunately, though, the machine suffers from its considerable size. At 11.7 by 9.6 by 1.4 inches and 5.73 pounds, the ThinkPad should slim down if it really wants to make an impact in this market.

The ThinkPad can be purchased through IBM PC Direct, dealers, and distributors. Available in two basic configurations, the ThinkPad comes with either an internal 60MB hard disk and one PCMCIA socket or three PCMCIA Type II sockets for storage, modems, and I/O networking. We tested the hard disk model, which is a good compromise configuration.

Handwriting recognition was particularly good, although gesturing and other pen operations were not nearly as precise as they had been with the VersaPad. Pen Windows isn't currently bundled with the ThinkPad, but the software will run on this unit.

GRiDPADsl

Let's cut to the chase. We did not like the GRiDPADsl. It scored poorly on just about all of our pen-based applica-

tions and did not fare well during usage testing. Handwriting recognition was slow and provided few performance options. This is problematic considering that the GRiDPADsl is a self-contained pen computer with no built-in keyboard.

Combine the GRiDPADsl's inferior performance with its high price tag (\$3,495) and average hardware (60MB hard disk, 386 CPU) and you end up with a pen system that is simply not a compelling buy.

DO YOU NEED A MAINSTREAM PEN COMPUTER?

Notwithstanding the still-developing nature of pen-computer technology, plenty of companies and individuals have already put pens to work for them. If you're a UPS driver, insurance adjuster, cop, or arson investigator, having a pen-based computer on which to take notes and fill out screen forms makes a lot of sense. But such users are the exception; pen-based computing remains a niche market. Most of us don't have to cradle our mobile PCs on one arm while trying to type with the other. We use our portables on airline tray tables, hotel desks, and boardroom tables. Pen computers offer no special interface advantage in any of these normal business venues, unless, of course, you are working in an environment (such as a library, archive, or conference room) where the clicking of keys would be an annoyance to those around you.

Even if pen applications become numerous and affordable, the pen just isn't going to replace the keyboard for much of our computer work. As our testing reflects, pen computers still have a long way to go toward offering as reliable and hassle-free a mobile computing environment as the better notebook machines already provide.

None of the applications we tested, nor any of the general-purpose applications we considered, would seem to need the pen. While pen-based applications will most certainly get a big boost from the PDA market, the fact remains that most of us just don't have a compelling reason to go penning around. □

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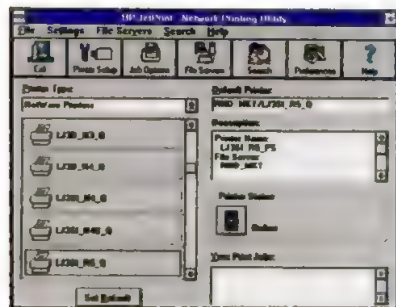
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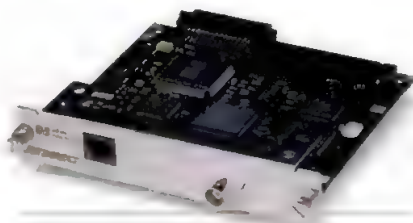
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of the PDA arena in price and performance. Although the Pen Pad has good physical design and satisfactory handwriting recognition, its value is limited by the absence of communications support and by lackluster software. Of course, the Pen Pad's value is only an issue if you can get one. Amstrad is negotiating for U.S. distribution, but as of press time, there are no firm plans.

Apple Computer Inc.

Apple Newton MessagePad

BY CHRISTOPHER BARR

More than a year after Apple's chairman, John Sculley, added the term Personal Digital Assistant (PDA) to the lexicon of computing, the Apple Newton MessagePad has arrived. The Newton is Apple's first PDA, and was developed in conjunction with Sharp Electronics Corp. Sharp is selling a version called ExpertPad. The Newton is a hand-held device that at first glance will delight and amaze you, but leaves you wanting more. The Newton foundation is solid, but missing pieces include critical wireless communications.

As the name implies, the Newton is a note taker, and it fits comfortably in your hand as you write on its 4.75-inch (diagonal) LCD panel. Although the Newton's handwriting recognition engine is one of the best we've seen—it translates cursive writing and printing, or any combination of the two—it remains far from perfect.

The Newton comes in three versions—depending on whether a modem and a connection to your desktop is included. But every Newton comes with an address book and a calendar with a to-do list. The Newton will store up to 250 name cards (with name, title, company, address, and three phone numbers), 200 notes of up to 50 characters, 500 calendar appointments, and 35 screens of uninterpreted text and drawings.

What makes the Newton stand out over the Tandy Z-PDA/Casio Z-7000 Personal Digital Assistant are the little touches. You can erase ink and text from both, but on the Newton the erased data becomes a cloud of dust before disappearing. The Newton's Intelligent Assistant feature uses key words to launch macro-like functions. When you write the phrase "fax Hillary" and press the Assist icon, the Newton will format a cover page and the message and use Hillary's fax number from the address book. Other key words include call, find, mail, and print. Write "schedule," press the Assist icon, and an appointment is added; write "remember" and an item is added to the to-do list.

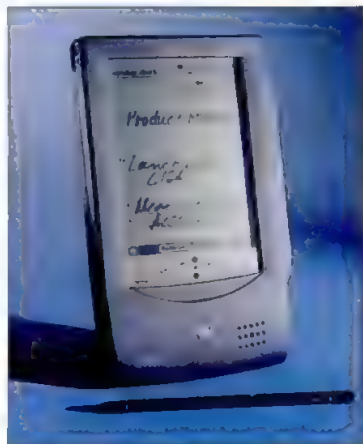
Like the Tandy/Casio, the Newton uses an untethered, passive pen. You launch applications by pressing preprogrammed icons at the bottom of the display. The applications, as well as the operating system, are stored in 4MB of ROM and run in Newton's 640K of system RAM. The operating system, which Apple calls Newton Intelligence, runs on a low-voltage 32-bit ARM 610 processor

operating at 20 MHz. The reflective LCD panel on which you write has a resolution of 240 by 336 lines and a contrast ratio of 6.4:1, well below the average of most notebook PCs.

The ExpertPad from Sharp Electronics differs from Apple's Newton only in its packaging. The ExpertPad is gray; the Newton is dark gray/green. The ExpertPad has a flip-top door to cover the screen, while the New-

ton has a slip-on leather case. The pen holder on the Newton is external, but it fits inside the ExpertPad's case. Otherwise, they are the same machine.

The Newton comes equipped with a serial port (it can be used to print to parallel printers with an optional cable), and an infrared transceiver to beam information from one Newton to another (up to three feet away). A Type II, Release 2, PCMCIA socket can be used



The Newton's "intelligent" PDA interface and operating system break new ground.

SUITABILITY TO TASK				
Apple Newton MessagePad				
	POOR	FAIR	GOOD	EXCELLENT
Daytimer	●	●	●	○
Communications	●	●	●	○
Custom applications	●	●	●	○
Handwriting recognition	●	●	●	○
Mobility	●	●	●	○

for additional storage or to add applications. Apple ships a PCMCIA ROM card with the Newton that contains a game to teach new Newton owners how to write to attain the best recognition. It serves double duty by instructing you how to use the PCMCIA socket. (Applications on a PCMCIA card appear as menu icons when you press the Extras button.)

The Newton is powered by four AAA batteries, which are included, or you can buy an optional rechargeable nickel cadmium battery pack (\$25). A lithium battery is used for back-up power. Because we examined a preproduction unit, we are unable to report accurate battery usage, but Apple claims most users will get from 5 to 32 hours on a set of batteries. In fact, that is considerably less than the Tandy/Casio's 100 hours.

Like a member of a royal family, the Newton's future is well planned. Matsushita Electric Co. licensed the technology from Apple and plans to develop its own Newton devices. Motorola is developing the MessageCard, which is a PCMCIA pager. In addition, Siemens and Rolm are working on the NotePhone—a telephone for the Newton. These first three versions of the Newton will be followed, beginning in 1994, by a family of various configurations.

A number of third-party software vendors have hitched their wagons to the Newton's star. Later this year you'll see applications like Fodor's travel guides from GeoSystems, business forms from PenMagic, and games from Blank, Berlyn, & Co.

Newton is very much targeted for vertical applications, too. Apple released the Newton Toolkit, which includes an object-oriented language called NewtonScript, that allows developers to easily create commercial or company-specific



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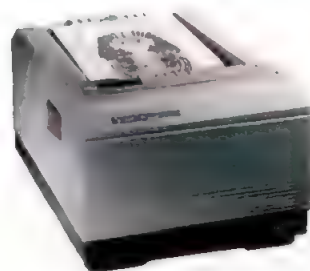
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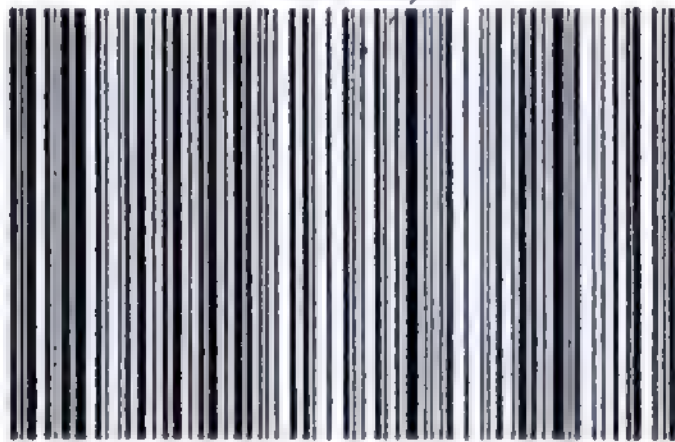


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1. Follow instructions on the other side

Back

0018-backslip



Inverted Back

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Folded edge of the page



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Inverted Foldout slip-sheet

Foldout slip-sheet



1. Open the foldout page
2. Insert this sheet with
 1. Front side touching the free page
 2. Arrow pointing to the fold
3. Slice the folded edge
4. Close the page and slip-sheet

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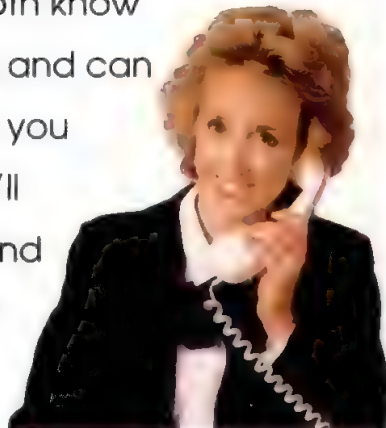
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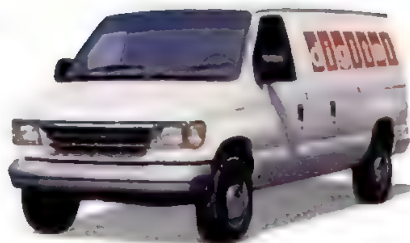
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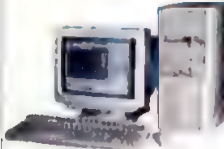
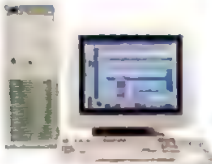
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Vertical-Market Pen Tablets

by Don Crabb

The number of pen-based vertical-market niches is growing at rates not expected a few years ago. Express delivery services, car-rental agencies, and other businesses with work forces involved in the collection of field data have started using specialized, slate-style pentop computers.

The growth in vertical-market solutions has helped improve the overall market for pen-based computing as technologies developed for specialty tablets (such as wireless communications and handwriting applications) are incorporated into mainstream pen-based computers. Here are four specialty pen-based systems that form a market cross section.

MICROSLATE DATELLITE 400L

MicroSlate (514-444-3680) will custom build Datellites and will work with you on writing and installing custom software. Depending on the configuration, these units can cost from \$4,995 to \$6,490. Rugged and bulky, Datellites weigh about 5.5 to 7 pounds, measure 12.5 by 10.5 by 3 inches or larger, can support as much as 16MB of RAM, have room for two data-storage devices, and have 9.5-inch displays that are backlit and VGA-compatible.

The \$2,295 MicroSlate Datelite 400L we looked at came with a Cyrix Cx486SLC processor, an 80MB internal hard disk, a 3.5-inch floppy disk drive, a 2,400-bps modem, serial and parallel ports, a VGA display connection, and a SCSI port. It uses MicroSlate's Veriflo simulated ink digitizer to capture pen input on-screen. The 400L can run on its batteries for about

3.5 hours of continuous use or 8 hours of normal on-and-off use.

PI SYSTEMS' INFOLIO 160

The \$2,249 Infolio 160 from PI Systems Corp. (800-831-6161) uses a 16-MHz Motorola 68331 and a proprietary operating system. The Infolio makes sense for a number of vertical applications, including remote data gathering and remote communications. Custom software development is a must, however, because the Infolio will not run DOS-based software.

The Infolio weighs 3.44 pounds and measures 11.13 by 9 by 1.2 inches. It

DATA ENTRY SYSTEMS SCRIPTWRITER II

The \$1,295 ScriptWriter II from Data Entry Systems (415-342-0893) serves as an electronic clipboard. Information is written with a pen or pencil onto a paper form that lies directly on a screen through which the information is stored into a database. The data can then be uploaded to a desktop computer via an RS-232 serial interface.

The ScriptWriter II comes with a minimum 128K of RAM and can be configured to hold several different form definitions. A typical form may contain up to 50 fields on a single page.

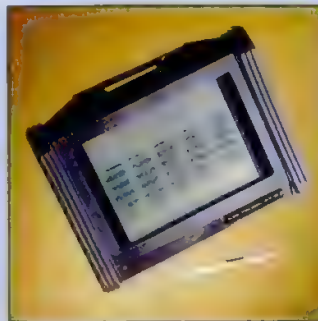
A document can run over several pages and contain up to 999 fields.

Data Entry Systems will custom design forms and a form-receiving database for you, but if you want to do it yourself, you can; the ScriptWriter II comes with Form Builder, Screen Builder, and Database Utility. The ScriptWriter II uses a proprietary character-recognition algorithm that needs less CPU horsepower than mainstream pen machines require because it only has to recognize block printing within the context of its screen forms.

INFORITE AS1050

The \$2,495 Inforite AS1050 from Inforite Corp. (800-366-4635) uses battery backed-up RAM for storage. On the AS1050, the signature pad is equivalent to the tethered Writing Pad MP 100, a PC add-on that captures signatures for computer-based forms.

UPS uses custom-configured Inforite tablets that let customers sign for their packages electronically. □



The MicroSlate Datelite 400L



Data Entry Systems' ScriptWriter II



PI Systems' Infolio 160



The Inforite AS1050

performed about as well as other Intel 80386-based systems we have tested. The unit that we tested came with 4MB of RAM and two PCMCIA Type II slots. The proprietary GUI is nicely intuitive, and the coarse-textured, 9.5-inch screen offers good traction for the stylus while displaying clear text and graphics.

programs on a Macintosh. A Windows version is scheduled for 1994.

While the Newton's cursive handwriting recognition and well-designed applications are appealing, you'll soon say, Where's the beef? More applications are available on the Tandy/Casio, but it doesn't deliver with the Newton's flair. It will take about a year before enough third-party applications will be available to make the Newton worth the price, and maybe longer before a company can develop meaningful vertical applications. In the meantime, your Newton will make you the life of the party.

Dauphin Technology Inc.

Dauphin DTR-1 Desktop Replacement

BY JEFF GREENBERG

The 2.5-pound Dauphin DTR-1 Desktop Replacement is a unique hybrid device that can serve as a portable pen computer, subnotebook, and desktop replacement. At \$2,495, the Dauphin DTR-1 is competitively priced with single-function pen computers and subnotebooks. If you want a multi-purpose computer, it's your best bet.

The Dauphin's 9- by 5- by 1.5-inch main module contains a Cyrix 25-MHz 486SLC processor, 4MB (expandable to 6MB) RAM, a 20MB or 40MB hard disk, and a 9,600/2,400-bps fax/data modem. The screen is a 3- by 5-inch monochrome display. Features include serial and parallel ports, external video, and an external floppy disk drive.

The Dauphin comes with MS-DOS 6.0, Microsoft Windows 3.1, Microsoft Windows for Pen Computing, and a reduced version of PenCell, which is a spreadsheet designed for Pen Windows. Although the Dauphin includes a standard fax modem, the user must supply fax software—that is, commercially available packages like WinFax. Also, the only

communications software provided is the Windows Terminal accessory; this application performs terminal emulation and file transfers.

Because it has pen capability, is relatively small, and has a built-in modem, the Dauphin could be used as a large, high-powered PDA. However, it lacks personal organizer software, wireless communications, and PCMCIA slots.

The Dauphin comes with a mini keyboard that has the same footprint as the main module. A leather carrying case holds the computer, keyboard, and wireless stylus. In addition, the Dauphin's portability is enhanced by an AC power adapter that measures a minuscule 4.12 by 1.62 by .87 inches.

The Dauphin's screen can be used in either portrait or landscape mode and provides a good writing surface for pen input. Although the screen is smaller than most other pen-based computers, it should be acceptable for most forms-based applications. But the Dauphin's pen-based computing abilities are tied to its use of Pen Windows, so its handwriting recognition suffers accordingly.

The Dauphin has a rugged feel and

comes with a slip-on plastic cover, which makes it easy to carry when used as a dedicated pen computer. Unfortunately, this configuration lacks a place to store the wireless stylus. And a 2.5-hour battery life may be the pen configuration's biggest weakness.

To use the Dauphin as a subnotebook, you can attach the unit, by velcro, to one side of the carrying case (which is included), and attach the keyboard to the other side. With the keyboard portion laying flat on a work surface, you can prop up the display for convenient viewing using a support easel built into the case. Unfortunately, the Dauphin is thicker and bulkier than most subnotebooks.

Although small, the LCD display provides a good level of brightness and contrast. Typing, however, is inhibited



The Dauphin is a small, versatile, 486-based pen unit with a detachable keyboard.

SUITABILITY TO TASK				
Dauphin DTR-1 Desktop Replacement				
	POOR	FAIR	GOOD	EXCELLENT
Daytimer	●	●	○	○
Communications	●	●	●	○
Custom applications	●	●	○	○
Handwriting recognition	●	●	○	○
Mobility	●	●	●	○

because the Dauphin's keys are only 16.5-mm wide and are a little stiff.

If you added a color monitor and full-size keyboard, you could use the Dauphin as a desktop computer. Its 486 processor and VGA subsystem, which supports 800-by-600-by-256 external displays, meets most desktop requirements. And with an optional internal Ethernet adapter, the unit can run on a network. On the other hand, the Dauphin's limited memory and disk capacities, in addition to the absence of expansion slots, prevent the unit from providing true desktop capacity.

Although the Dauphin is not the best product in any of the categories in which it can serve, its strength lies in its versatility. Most subnotebook computers can be used as desktop replacements, but there is no product available that makes the transition to a dedicated pen configuration as effectively as the Dauphin.

EO Inc.

AT&T EO 440

Personal Communicator

BY CHRISTOPHER BARR

The AT&T EO 440 Personal Communicator is not a "pure" PDA or a personal organizer, nor is it a desktop replacement. The EO, which officially is called a personal communicator, is designed for use by mobile workers who want fax, e-mail, and voice contact while on the go.

Comparing the EO to PDAs such as the Apple Newton MessagePad and the Tandy Z-PDA/Casio Z-7000 Personal Digital Assistant is like comparing a motorboat to a car—both use engines and carry people from one point to another,

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CIRCLE 119 ON READER SERVICE CARD

but the purpose, method, and ease-of-use paradigms are totally different. The EO is more than twice the size and weight of the Newton and the Tandy/Casio. Also, it is strictly a business communications device, while the Tandy/Casio will be sold into the consumer electronics market, and the Newton will eventually cross into both markets.

The stripped-down version of the EO with 4MB RAM is priced at \$1,999, but is unable to handle fax or e-mail without adding a modem and 4MB more RAM. With options and accessories such as a fax modem, cellular phone, 20MB hard disk, and 10MB SunDisk PCMCIA storage card, the cost runs to \$4,000. The EO uses an untethered active pen, and runs GO Corp.'s PenPoint in 8MB of ROM on a new 3.3-volt RISC processor from AT&T Microelectronics called the Hobbit chip. (AT&T owns part of EO and GO Corp.)

The EO 440 measures 10.8 by 7.1 by 0.9 inches (HWD) and weighs 2.2 pounds. Standard ports are parallel, proprietary serial, PS/2-compatible keyboard, and telephone, and a connector that accepts the wireless communications module, which is a cellular phone that can also fax. Ross Perot-like ears on either side of the LCD panel are a speaker and a microphone for voice annotation. The EO accepts standard JEDEC DRAM cards and has one Type II PCMCIA socket that accepts SunDisk silicon hard disks. The screen is a 7.5-inch (diagonal)

reflective LCD panel, which is difficult to read without adequate ambient lighting.

When it comes to power, the EO is more like a notebook than a PDA. Its nickel cadmium batteries last about 4 hours between charges. Using the cellular option drains the power in about half the time.

The EO comes with nine applications, including a personal information manager from Pensoft called Personal Perspective. The operating system supplies the key applications such as Fax; Mail, which provides you with an AT&T Mail account; MiniNote for jotting notes and making light sketches; MiniText for handwriting recognition; and GOWrite,



The EO pairs pen computing with cellular phone, e-mail, and fax options.

which is the handwriting recognition engine. In addition, you can fax or mail from any document, and the EO uses an inbox/outbox metaphor so you always know the status of your messages.

As a personal organizer, Personal Perspective has a day planner and an address book, which becomes the universal database for the telephone and fax numbers in all your applications.

EO Phone is convenient—it lets you make either cellular or telephone line calls from your unit. You can select a number from the address book, or tap in a number on the on-screen keypad. However, setting up either a land line or a wireless connection takes some doing.

The unit comes with an AT&T Mail account that has gateways to other public messaging systems like MCI Mail and CompuServe. The benefit of AT&T Mail is that you send and receive faxes in your mailbox, and view them on the EO.

The EO has numerous features that mobile professionals may desire, like faxing or communicating from practically anywhere, but as a whole it is less than the sum of its parts. To tick off a few of its shortcomings, it has no print or fax preview, and limited printer support. System performance is slow, and there are few connectivity options. The EO comes

with SunSelect's PenCentral to connect to a PC, but you can't install a network card in the PCMCIA socket to enable a group of EOs to communicate.

The EO 440's companion in the EO line is the EO 880, which is larger (13 by 9 by 1.1 inches), heavier (4 pounds), faster (30 MHz), and more expensive (\$2,999). The EO 880 has an extra PCMCIA slot, a 64MB hard disk, and a SCSI II port.

The EO 440's first users will not constitute a broad horizontal customer base, but rather targeted vertical markets that will use a software development kit to create specialized communications-oriented applications. EO assures us that future EO machines will be more powerful and less costly, and will have better integrated applications.

Fujitsu Personal Systems Inc.

Fujitsu 325Point

BY DON CRABB

The Fujitsu 325Point is a pen-based computer from Fujitsu Personal Systems, which, under its former name, Poquet Computer Corp., made the smaller (and slower) pen unit, the PoquetPad. The 325Point is a customizable pen-based computer meant for vertical applications and can serve as a replacement for a notebook machine. But though the 325Point could serve the needs of many specialized industry applications, we found its overall performance less than dazzling.

The 325Point weighs 3.35 pounds and comes with 4MB of RAM (expandable to 12MB), a 42MB IDE hard disk, two PCMCIA Type III sockets, and a JEIDA (Japan Electronic Industry Development Association) memory-card port. It comes with either Microsoft Windows for Pen Computing, GO Corp.'s PenPoint, or Communication Intelligence Corp.'s PenDOS pen-based operating systems.

The 325Point's processor is a low-voltage (3.3-volt) AMD 25-MHz 386XLV (also used in the Toshiba T100X Dynapad). The 325Point's 640-by-480 backlit transreflective supertwist LCD occupies most of the top of the 11.7-by-8.7-by-1.16-inch case.

The 325Point also comes with a serial port, a parallel port, and an external port

SUITABILITY TO TASK

AT&T EO 440 Personal Communicator

	POOR	FAIR	GOOD	EXCELLENT
Daytimer	●	●	●	○
Communications	●	●	●	●
Custom applications	●	●	●	○
Handwriting recognition	●	●	○	○
Mobility	●	●	●	○

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CIRCLE 289 ON READER SERVICE CARD

■ Keyboard-Based Organizers

by Jeff Greenberg

Though there is no universally accepted specification for the functionality of a PDA, it is commonly assumed that pen-based input is required. However, cost and still-developing handwriting applications may discourage some potential PDA users. Until these issues are improved, people might want to consider keyboard-based organizers.

These units come in two categories: palmtops and subnotebooks. Palmtops are designed to be as small as possible, sacrificing touch typeability and screen legibility for pocketability. Subnotebooks are larger and heavier than palmtops, but they have larger screens and more comfortable keyboards.

CASIO

Casio's B.O.S.S. family of electronic organizers runs from under \$100 to \$450 for the top-of-the-line SF-R20. The B.O.S.S. SF-R20 palmtop's screen has an excellent contrast ratio and can display either 10 lines of 40 characters or 5 lines of 30 characters. The keyboard, which has over a dozen special-purpose function keys, seems cluttered. This, combined with an unusual menu and command metaphor, makes the SF-R20 the hardest organizer to learn.

The weak link of the SF-R20 is its communications capability. An optional PC Link kit lets you transfer data records between the SF-R20 and a PC-based PIM that emulates the organizer. A 2,400-bps modem is available, but there is no general-purpose serial communications.

The SF-R20's applications include Lucid's 3-D Spreadsheet, a calculator, a text processor, an international time-zone clock, a telephone list, and a business-card database. Users can view the schedule two months, one week, or one day at a time. The unit's reminder function is one of the most flexible repeat-activity scheduling systems around.

Overall, the SF-R20 is best suited for

standalone use (that is, not in conjunction with a PC), where scheduling is a priority and word processing and communications are less important.

HEWLETT-PACKARD

The HP 95LX Palmtop PC and HP 100LX Palmtop PC are the only palmtop organizers that run DOS. Both have a credit-card expansion slot, but only the HP 100LX's slot is PCMCIA 2.0 compliant. The HP 100LX's screen has a good contrast ratio and can display up to 25 lines of 80 characters. Both run on a pair of AA alkaline batteries, but the HP 100LX can also run on and recharge nickel cadmium batteries.

The HP palmtops are the leaders in palmtop communications. An infrared transceiver lets an HP palmtop wirelessly communicate with another HP or any device equipped with an optional infrared transceiver.

A specially designed cradle lets you carry your HP and a communications peripheral in one small package. U.S. Robotics makes a modem that fits in this cradle, and Motorola and SkyTel offer paging devices for it.

HP 95LX comes with Lotus 1-2-3, data communications, an appointment book, phone book, word processor, and calculator. The HP 100LX has all this plus Lotus Development Corp.'s cc:Mail and a stop watch, a general-purpose database, a world time system, and a notepad. The HP 100LX word processor includes an outliner, multiple fonts, and headers and footers.

For a full-size screen and keyboard, check out the HP OmniBook 300 (\$2,375). Like palmtops, the OmniBook has a nonbacklit reflective screen, a full set of PIM applications, and no disk drive (a model with an internal hard disk is available). The screen has a good contrast ratio, but it can be hard to read in dim light.

Like notebooks, the OmniBook has a 386 processor, serial and parallel

ports, and a VGA display. It comes with Microsoft Windows, Excel, and Word for Windows; HP's own PIM; and an innovative pointing device that tucks into the right side of the computer. The absence of an external video port combined with the nonbacklit screen means people probably won't want to use the OmniBook as their only computer.

Expansion is one of the OmniBook's strengths. It comes with four PCMCIA Type II slots. One of these slots is used for the system software, and depending on whether you choose the model with 10MB of solid-state memory or a 40MB hard disk, your base system will use another one or two slots, respectively.

OMRON

Some people want the functionality and affordability of a palmtop but don't want to be inconvenienced by tiny screens and keyboards. The Omron Toucan Personal Digital Companion gives these users a new choice. For \$899 the Toucan provides all the functionality of a palmtop organizer in a package that has a large 4- by 6-inch screen and 15 mm key spacing. While the keys are closer together than the 19mm spacing found on standard keyboards, they are far enough apart that touch typing should be possible for most people.

The Toucan is a DOS computer built around an 8-MHz Chips & Technologies processor and is equipped with 2MB of RAM, a fax/data modem, and two PCMCIA 2.0 expansion slots. The Toucan's software includes the DataSel Gold contact manager, an appointment scheduler, a form letter generator, a label generator, LapLink XL, and Bit-Com communications software.

PSION

At 6.5 by 3.3 by 9 inches, the Psion Series 3a Palmtop Computer is the smallest organizer we tested. By using a pull-down menu system, Psion eliminated most of the function keys, resulting in

an uncluttered keyboard and intuitive operations. Psion even squeezed in an LCD as big as those found on the HP LX and B.O.S.S. SF-R20 palmtops. The high-contrast display works well in a variety of lighting situations. The Psion supports four levels of viewing, ranging from 9 lines of 45 characters up to 18 lines of 90 characters. Two proprietary slots let you add software modules or more memory.

The Psion's most innovative capability is a digital audio system that lets you record and play sound clips. These clips can even be embedded in other applications.

If you use the Psion in conjunction with a PC, the optional Serial Link kit is a must. The kit lets you transfer files to and from your PC, print to a wide variety of printers, and connect to most external modems.

The scheduler has six views, including year, week, day, to-do list, anniversary, and chronological list. The word processor includes styles, outlining, print preview, headers and footers, and a WYSIWYG display. The spreadsheet can save files in Lotus-compatible formats. Other applications include a calculator, world time system, alarm clock, and electronic phone book.

SHARP

Sharp offers an entire line of Wizard personal organizers, from under \$100 to \$649 for the Sharp Wizard OZ-9600II. The OZ-9600II is the only Wizard that has pen input—for writing

and drawing—but it lacks handwriting recognition. It uses four AAA batteries and comes with 512K of memory and one proprietary expansion slot.

Two types of communications are available: infrared and serial. Infrared communications can involve another Wizard or a PC or printer equipped with a Sharp infrared transceiver.

The OZ-9600II is the biggest of the

Wizards and has the largest screen. The 2.75- by 3.75-inch screen has a resolution of 320 by 240 pixels and a fair contrast ratio, but its highly reflective screen can be difficult to read.

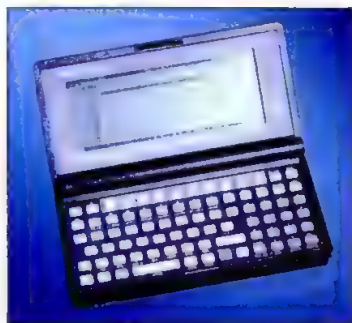
Standard applications for the OZ-9600II include a calendar, scheduler, calculator, to-do list, anniversary list, phone book, address book, international clock, text processor, outliner,

and simple drawing package.

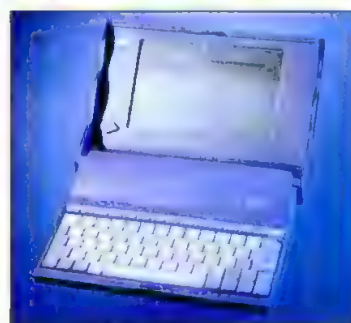
The OZ-9600II has a special filing system that lets you incorporate records from different Wizard applications into one folder. This makes it easy to locate all information relevant to a specific topic or project. There is even a global search function that creates a new folder by scanning every record on your Wizard for a specified keyword.

ACCESSORIES

Not every keyboard-based organizer comes with all the functionality you might want in a PDA. If a particular organizer is missing a feature you need, you may be able to add that functionality with a third-party upgrade. For example, the U.S. Robotics (708-982-5010) WorldPort Palmtop Fax/Data Modem (\$249) can send a fax from almost any electronic organizer. IntelliLink Corp. (603-888-0666) offers a \$99.95 package that can synchronize a wide variety of PIMs, and the BSE Company (602-527-8843) sells a \$79.95 compact serial-to-parallel converter. □



An alternative to PDAs are keyboard-based personal organizers, which generally are less expensive than PDAs but lack their sophisticated interface and communications capabilities. Clockwise from bottom left: the HP OmniBook 300, HP 100LX Palmtop PC, HP 95LX Palmtop PC, Psion Series 3a Palmtop Computer, Casio's B.O.S.S. SF-R20, Sharp Wizard OZ-9600II, and Omron Toucan Personal Digital Companion.



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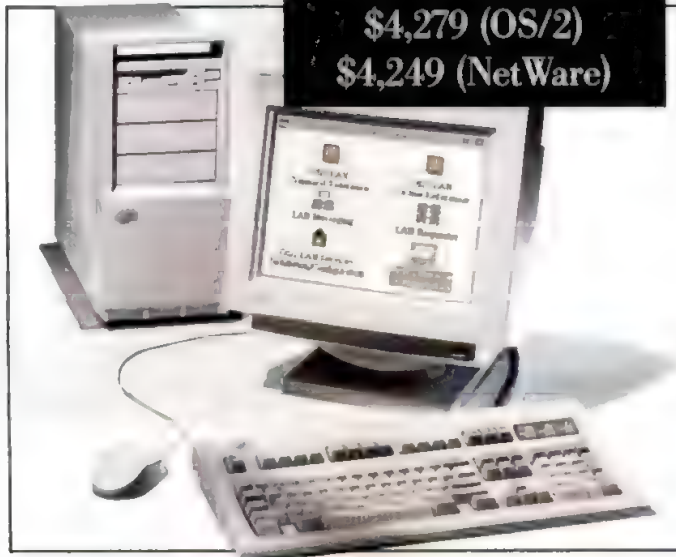
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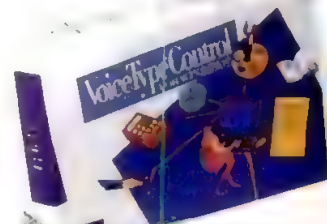
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for a VGA monitor. An external floppy disk and keyboard are options. It lacks a docking station and high-speed networking port, although an optional PCMCIA Ethernet card may be added. This card makes the 325Point a reasonable choice to live on a NetWare network. No Token-Ring card is available.

Fujitsu claims that its power-saving circuitry can get as much as 7.6 hours from a single charge. The unit is likely, however, to run out of power after roughly 3 hours—the lower end of the range Fujitsu claims. Battery recharging took 4 hours with the unit on and 1.5 hours with it off. The 325Point uses a passive Wacom pen stylus that doesn't use batteries, an advantage over the Dynapad, which uses an active CalComp digitizer.

We had difficulty performing basic file-management, software-loading, and file-import functions using the PenPoint operating system. We tested a beta unit, however, and Fujitsu is working to iron out the wrinkles.

During Suitability to Task analysis, we found screen images barely visible under harsh overhead lights and not at all visible in bright sunlight, regardless of the backlight adjustment. A little angling was required to attain adequate visibility so that we could perform the tests. Notetaking, however, was a breeze. The electronic ink flowed smoothly (much better than the Dynapad's), and the screen display was very solid while being written on.

The 325Point's handwriting recogni-

tion capabilities were only fair. The machine handles uppercase and lowercase block letters as long as they are written within screen-defined handwriting areas.

The 325Point can recognize predefined and user-defined gestures, which are helpful when writing and editing. You can also turn off handwriting recognition until you have written a page or filled out a field to help speed the process along. Overall, we found the 325Point's handwriting recognition and pen proficiency to be better than the Dynapad's and more like the Apple Newton's.

As a mobile computer, the 325Point was above average, thanks to its good battery life and PCMCIA modem options. Be-



The 325Point is a customizable pen tablet for vertical applications.

cause you can add a keyboard, an external VGA monitor, an external floppy drive, and a Lap-Link or other desktop-PC serial connection, the 325Point can serve as an everyday machine. Its small 42MB hard disk, however, might be a problem. With the judicious use of JEIDA and PCMCIA memory cards, its storage capacity could be extended. These cards are expensive, however.

The 325Point is a flexible pentop computer that could be used for a number of vertical applications, but because of its size, weight, lack of wireless communications options, and lack of a suite of built-in personal organizer tools, we would not recommend it as a suitable PDA replacement.

AST Research Inc.

GRiD PalmPAD

BY DON CRABB

The GRiD PalmPAD is a small pen-based computer designed for rough use and aimed primarily at field users who abuse machines or who work in harsh environments. It's appropriate in these situations despite its painful PenRight! interface and slow 9.5-MHz NEC V20 CPU.

It is this CPU that is the PalmPAD's most prominent drawback. It encumbers



The PalmPAD is a ruggedized 2.9-pound pen computer with a built-in radio modem.

its host in the same way it hampers the older PoqetPad. Unless you are running simple form-based programs, you probably won't be happy with the computing speed or prowess of the PalmPAD.

The PalmPAD is ruggedly built and has an exterior that is molded almost entirely out of a single piece of plastic, with rubber seals around the screen and control buttons that effectively protect the unit from drops and spills. Also ruggedized are a built-in radio and a number of modem options.

The PalmPAD weighs 2.9 pounds and measures 9 by 6.25 by 1.9 inches. It is small enough to attach to your wrist or belt and will run all day on a single set of batteries.

The PalmPAD doesn't support GO Corp.'s PenPoint or Microsoft Windows for Pen Computing. It runs a proprietary operating system, PenRight!, that lacks handwriting recognition and is essentially DOS with a stylus-based, keyboard touch-screen interface. The PenRight! interface lets you point at icons on-screen to control and run applications.

During testing, we found that the applications we were able to load were both slow to launch and slow to respond. When you combine this decidedly sluggish performance with a poor display—the PalmPAD's 6.5-inch (diagonal) 640-by-400 backlit transreflective LCD screen has only two shades of gray and no true black—you end up with a pen computer that is more of a curiosity than a useful tool for handling daily computing needs.

The PalmPAD comes with a scanty 2MB of RAM, which cannot be upgraded. It also has no internal hard disk. It does, however, have a PCMCIA

SUITABILITY TO TASK

Fujitsu 325Point

	POOR	FAIR	GOOD	EXCELLENT
Daytimer	●	●	○	○
Communications	●	●	●	○
Custom applications	●	●	●	○
Handwriting recognition	●	●	○	○
Mobility	●	●	●	○

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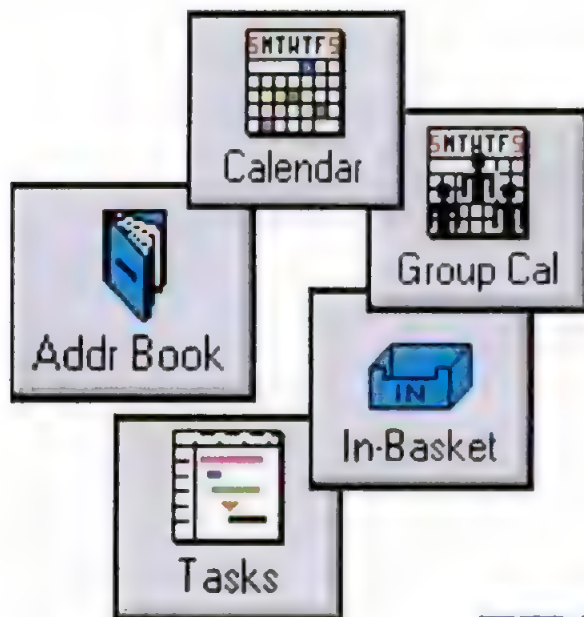
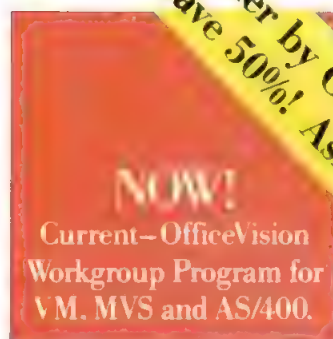
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■ Pen Operating Systems

by Bruce Brown

The adage that computers are only as good as their operating systems is particularly true with pen-based systems. As pen devices strive for recognition and legitimacy, several features have vital roles: the operating systems that make the hardware bits and pieces work together, the associated user interfaces, and the applications that finally must carry the burden of proving pen systems useful. Because applications are written based on the rules and features of particular operating systems, pen operating systems are key to pen computing success.

Currently there are four major pen operating systems: AST Research's PenRight!, GO Corp.'s PenPoint, Microsoft Windows for Pen Computing, and CIC's PenDOS. All four are available for multiple pen computing devices. None of the four is proprietary, as is the case with systems designed concurrently with hardware.

The first pen operating system, AST Research's PenRight!, originally available only on GRiDPAD units, was used mostly for forms-based data entry. Because of the number of vertical and custom applications that have been written for it, PenRight!, which is now also available on non-GRiD hardware, is currently the operating system of choice for vertical markets.

GO Corp.'s PenPoint is a 32-bit operating system that includes preemptive multitasking and a protect mode. Its interface uses a tabbed notebook and table of contents metaphor. Often initially confusing, especially to people used to DOS or Windows interfaces, PenPoint has many advantages. All PenPoint application programs are installed automatically and remain in the background, and users can call

them up at any time to work with relevant data. Sharing data between applications is an integral feature with PenPoint, not just a possibility, as with most other pen operating systems.

PenPoint's preemptive multitasking gives priority to pen input at all times, and the protect mode means that if a given application in PenPoint should crash, other tasks are not interrupted. PenPoint was intended to be used particularly for mobile communications. Current communication applications include GO Fax, GO Mail, and the GO Message Center.

PenPoint was designed specifically for pen computer use (that is, it's pen-centric) and is most appropriate for field applications where PenPoint's strengths can be used, rather than in applications where reliance on existing

based programs, can make Pen Windows as pen-aware as PenPoint, with the added advantage of sharing data with programs that aren't pen-aware. If you want a pen system for forms and the ability to run Windows or multiple DOS applications, Pen Windows is your best bet.

CIC's PenDOS is also not an independent operating system; it's an operating environment that works directly with DOS. PenDOS adds handwriting recognition and the ability to use a pen for input to all installed DOS applications. Recognition technology development (voice and image, as well as handwriting) is CIC's major direction.

Apple's Newton Intelligence, the pen operating system that will run on the Apple Newton, has a feature that automates tasks by reacting to action words such as "call" and "send." Its recognition engine will learn individual writing styles. Newton Intelligence also has graphics creation and completion tools, as well as communications features.

GeoWorks' GEOS for the handheld Tandy Z-PDA/Casio Z-7000 Personal Digital Assistant is an object-oriented graphical user interface and operating system that can run on low-power CPUs where 100-hour battery life is the design target.

The Amstrad Pen Pad PDA600's operating system, which was written by Amstrad, is object oriented with a user interface that looks like a notebook with page tabs. Pen Pad applications will be distributed via PCMCIA cards.

If pen computing becomes popular, standards will likely prevail, and proprietary solutions will fall from common consideration as hardware and software vendors fight to build user bases and increase profitability by adopting a standard operating system. □

As pen devices strive for legitimacy, it's the operating systems that must carry the burden of proving their usefulness.

DOS and Windows applications is a high priority. You can import and export DOS application data with PenPoint, but the process is not as simple as when working in DOS or Windows.

Microsoft Windows for Pen Computing isn't an operating system; rather, it's an operating environment that adds handwriting recognition as well as the ability to use the pen to input data and drawings in traditional Windows applications.

The major advantages of Pen Windows are a short learning curve for those millions who already use Windows and the immediate availability of applications that let you use the pen.

Applications written specifically for Pen Windows, such as the Slate Day-Timer personal information manager, and vertical applications such as forms-

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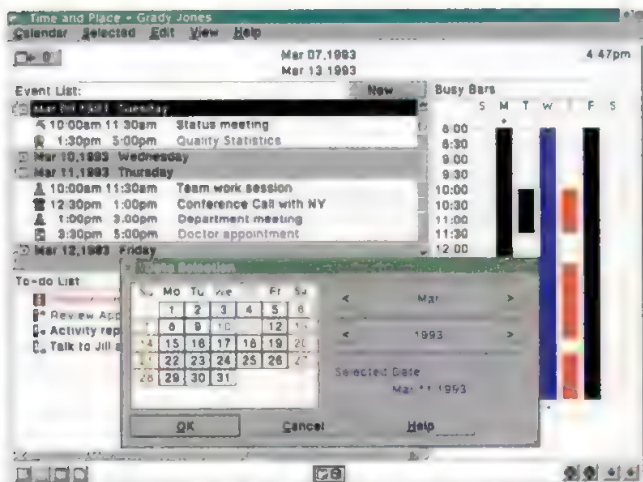
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SUITABILITY TO TASK				
GRiD PalmPAD				
	POOR	FAIR	GOOD	EXCELLENT
Daytimer	●	○	○	○
Communications	●	●	●	○
Custom applications	●	●	○	○
Handwriting recognition	●	●	○	○
Mobility	●	●	●	○

Type I slot (with a built-in IDE controller) that can hold SunDisk flash-memory cards of up to 30MB in size. Unfortunately, though, the PCMCIA slot lacks an eject mechanism. If the PCMCIA card you plug in doesn't have a pull tab, you must resort to a pair of needle-nose pliers to pull the card out.

Because of its processor, the PalmPAD is too slow to be used as an everyday notebook computer. It also can't be considered a PDA because it is too big, too heavy, and lacks integrated personal organizer tools and handwriting recognition. With, however, its high-speed modem options and cellular radio, the PalmPAD has PDA-like communications capabilities.

The PalmPAD is best used as a device for remote data-collection tasks (such as taking warehouse inventory), when using a keyboard can be cumbersome and time consuming. Its slow processing speed and lack of a built-in hard disk (hard cards notwithstanding) limit its appeal and usability. Add to that the frustration of using PenRight! and you've got a machine that's definitely suited only for specialized uses that demand ultrarugged pen-based computers.

Tandy Corp.

Tandy Z-PDA

Casio Inc.

Casio Z-7000

Personal Digital Assistant

BY CHRISTOPHER BARR

This PDA (formerly called Zoomer) is the sporty progeny of two consumer electronic giants, Tandy and Casio. Casio has longtime experience making its B.O.S.S.

personal organizers, and Tandy has spawned thousands of retail outlets stocked with electronic gadgets.

The Tandy/Casio has been granted the best of both worlds. Shoehorned into 4MB of system ROM are more applications than can be described in one breath. The Tandy/Casio is a personal organizer, notetaker, and sketch pad, and it comes with Pocket Quicken (a subset of Intuit's Quicken desktop personal finance software) to track your spending. It also has a front end to America Online that can be used for sending faxes and e-mail and for reading stock quotes, news, and weather reports.

Solitaire and two other games are installed, as is a dictionary, a translator for 26 languages, and a calculator. It comes with a conversion calculator with predefined fields to determine currency exchange values and loan amounts, and it performs other simple financial figuring. The conversion calculator can also tell you how many acres are in a square mile and how many cups it takes to make an imperial gallon. Other categories include length, mass, temperature, time, and velocity. Most of the applications are accessed by pressing one of the pre-programmed icons at the bottom of the Tandy/Casio's display.

All this fits in the palm of your hand for a street price of around \$700. The Tandy/Casio measures 4.2 by 6.8 by 1 inch, comes with 1MB of RAM, and weighs an even 1 pound. The 4.75-inch (diagonal) reflective monochrome LCD panel, which you write on with a miniature pen that telescopes from 2.75 to 4 inches, has a resolution of 320 by 256 pixels. The pen, which is passive (meaning you can use your finger or other instrument), is stored in a silo.

The Tandy/Casio comes with an external power hookup, contrast and volume controls, a headphone jack, a proprietary serial port, a single PCMCIA Type II socket, and an infrared trans-

ceiver. A single-button cursor control and two Nintendo-like "fire" buttons will be available for future software releases. Accessories such as a printer cable, an AC adapter, extra pens, and software to link to a PC should be available soon.

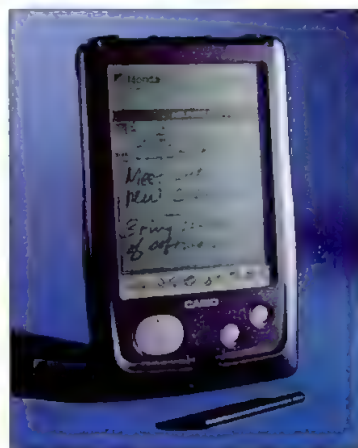
The Tandy/Casio's multitasking operating system from GeoWorks, called GEOS, has a graphical user interface and provides users with the file manager, various printer and communications drivers, and a pop-up keyboard that can be used instead of the pen. The PCMCIA socket can be used for a modem, adding applications, or providing additional storage. When you add

applications on a PCMCIA card, the new programs appear as menu choices on the launcher icon.

The Tandy/Casio runs on three AA batteries and comes with two lithium backup batteries that will keep your applications in memory during a battery change. Since we tested a preproduction model, the results of our battery rundown tests cannot be considered accurate, but

Tandy and Casio estimate the Tandy/Casio's battery life at about 100 hours.

The outstanding battery life comes at the price of performance. While the Apple Newton MessagePad and the AT&T EO 440 Personal Communicator use new 32-bit processors, the Tandy/Casio uses a proprietary processor developed by Casio that is the

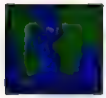


With America Online and game buttons, the Tandy/Casio mixes business and pleasure.

SUITABILITY TO TASK				
Tandy Z-PDA/Casio Z-7000 Personal Digital Assistant				
	POOR	FAIR	GOOD	EXCELLENT
Daytimer	●	●	●	○
Communications	●	●	●	○
Custom applications	●	●	○	○
Handwriting recognition	●	●	○	○
Mobility	●	●	●	●

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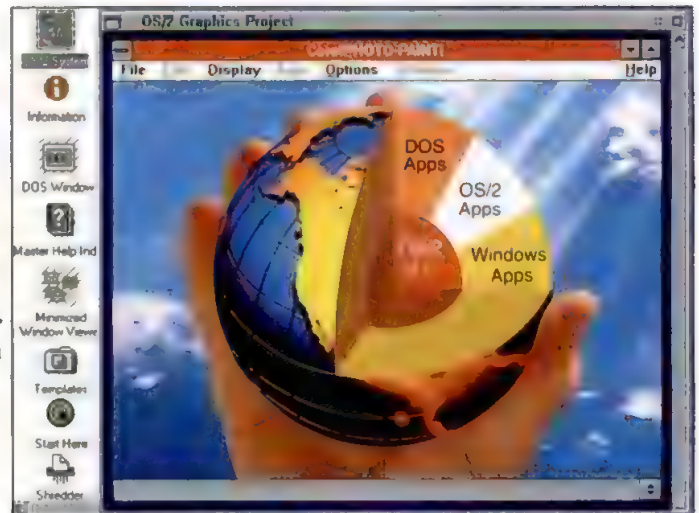
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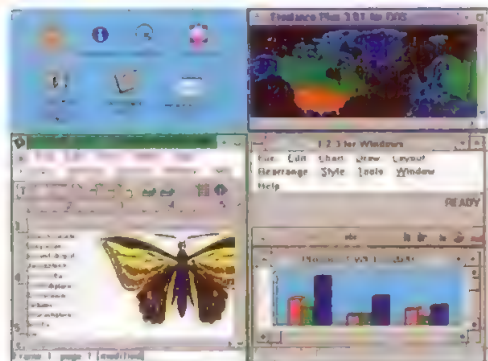
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■ No Tabula Rasa: *Handwriting*

by John R. Quain

In trying to interpret your scribbles, tablets and PDAs face a welter of complex problems, including co-articulation (the blending together of letters in longhand), word segmentation (determining when one word ends and the next starts), and just plain sloppy handwriting.

In an effort to solve these problems and turn poor penmanship into neat ASCII text, a host of techniques, including neural networks, probabilistic Markov modeling, fuzzy logic, dynamic programming, and clustering algorithms, are being employed. But using just one of these approaches isn't enough. The handwriting recognition software used in the Apple Newton MessagePad, for example, works with multiple recognizers, among them Paragraph International's cursive handwriting recognition software. Most companies are extremely secretive about the strategies they're using to find handwriting's Rosetta Stone, but the majority of programs use a similar combination of techniques to translate printed and cursive handwriting into fancy fonts.

Initially, the handwriting is stored as electronic ink, which is essentially a bit-map containing particular data points and coordinates. Other data elements, such as the thickness of the lines and the time, speed, and order of the input may also be stored in ink files.

Most of the first generation of PDAs can only recognize and translate block printing. Microsoft Windows for Pen Computing is a typical block printing recognition system. After storing your printed words as ink, the software uses feature extraction that looks for salient elements—such as the number of points and the shapes used in the printing—to compare against a data-

base of letters. To further improve the software's accuracy, the words can be compared against a 20,000- to 40,000-word dictionary, adding an element of contextual matching to the equation. Proper names can be added to the dictionary, and if what you've written is interpreted as gibberish, the program will ask you to correct it.

Microsoft's system also allows you to train the software so that it will recognize idiosyncrasies in your script. However, it is only a partial solution, for it is unable to recognize difficult cursive or longhand writing and more prone to making mistakes than not.

Lexicus' Longhand is a recognition engine specifically designed to recognize the combination of longhand and printing that most of us use. Described

based samples. The second uses a 20,000-word dictionary to limit the scope of the search. The third element assimilates your writing into the modeling to improve the accuracy of subsequent translations.

The development of a standard file format for ink would help establish ink as a data type. The major contender here is Jot 1.0, intended to help in the manipulation of electronic ink and facilitate the use of various handwriting-based programs. Jot 1.0 files include pen-centric information like the amount of pen pressure, order of the strokes, speed of writing, writing angle, sampling rate, and color.

Other techniques that could improve handwriting recognition are not commonly used today because they

simply demand too much processing power. Neural network approaches, for example, have processor demands that far outstrip the power of first generation

Most companies are extremely secretive about the strategies they're using to find handwriting's Rosetta Stone.

as writer-independent, Longhand uses pattern-recognition algorithms to match your writing with its database of patterns. A built-in 25,000-word dictionary is used to provide contextual information.

If Longhand doesn't think the final translation is legitimate, the program offers five approximations to choose from, or it lets you enter a correction of your own, training the program in the process. Longhand will run under both Go Corp.'s PenPoint operating system and Pen Windows.

A promising new program is IBM's ThinkWrite Unconstrained. Expected to ship to OEMs this fall, ThinkWrite translates sloppy cursive handwriting into text. The program has three main elements. The first uses the Markov probabilistic modeling technique to match your handwriting to statistically-

personal digital assistants.

Another promising solution is to use a grammar guide that follows flexible (formal and colloquial) syntax and context rules. An accurate grammar guide for rough, everyday English could predict what word should follow another; that feature would greatly improve the accuracy of translations. Unfortunately, a major constraint here is memory. Loading an entire grammar guide with all of its rules and syntax requires more RAM than is available in the PDAs that are on the market today.

Many developers contend that until the hardware offers finer resolutions, higher sampling rates, and more computing power, cursive handwriting recognition won't improve much. In the meantime, early adopters will either have to improve their handwriting or get used to block printing. □

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starts here.

Fact Files: PDAs

► Amstrad Pen Pad PDA600

Amstrad, 169 Kings Rd., Brentwood, Essex, CM144EF, England 011-44-277-228888.

Estimated price: \$399 with 128K RAM.

Options: Serial cable, \$30; serial cable with Centronics adapter, \$60; backup and restore software with serial cable, \$75.

Weight: .88 pounds.

Batteries: Uses three standard 1.5-volt or AA pen-size alkaline batteries. Average life of 40 hours.

CPU: 20-MHz Zilog Z8S180.

Display: 240 by 320 pixels, .28mm dot-pitch reflective LCD measuring 2.88 by 3.62 inches.

Circle 452 on reader service card

► Apple Newton MessagePad

Apple Computer Inc., 20525 Mariani Ave., Cupertino, CA 95014; 800-776-2333, 408-996-1010.

Estimated street price: \$699 with 640K RAM. Newton Communications System (includes 2,400-bps send/9,600-bps receive fax modem), \$799; Newton Professional Communications System (includes 2,400-bps send/9,600-bps receive fax modem and Macintosh or PC software for Newton Connection Kit Pro), \$899.

Weight: 0.9 pounds.

Batteries: Uses four 1.5-volt or AAA batteries. Average life of 5 to 32 hours.

CPU: 20-MHz ARM610.

Display: 240 by 336 pixels, reflective LCD measuring 3.96 by 2.83 inches.

Operating system: Newton Intelligence. Circle 453 on reader service card

► Dauphin DTR-1 Desktop Replacement

Dauphin Technology Inc., 377 E. Butterfield Rd., #900, Lombard, IL 60148; 800-782-7922, 708-971-3400.

Estimated street price: \$2,495 with 4MB RAM, 20MB hard disk, and 9,600-bps fax/2,400-bps data modem.

Options: Replacement battery, \$89;

external 3.5-inch floppy disk drive, \$199; 2MB upgrade, \$199; 40MB hard disk, \$200; Ethernet card, \$299.

Weight: 2.5 pounds.

Batteries: Uses one nickel hydride battery. Average life of 2.5 to 3 hours.

CPU: 25-MHz Cyrix 486SLC.

Display: 640 by 480 pixels, 16-gray-scale backlit VGA measuring 6 inches diagonal. Supports external 800 by 600 pixels on a Super VGA monitor.

Operating system: DOS 6.0, Microsoft Windows 3.1, and Microsoft Windows for Pen Computing preinstalled.

Supports IBM's PenDOS and AST Research's PenRight!

Circle 455 on reader service card

► AT&T EO 440 Personal Communicator

EO Inc., 800A E. Middlefield Rd., Mountain View, CA 94043; 800-458-0880.

List price: \$1,999 with 4MB RAM.

Options: AC adapter, \$99; 7-hour battery, \$99; EO keyboard, \$99;

Plantronics headset, \$119; floppy disk drive, \$199; 4MB RAM, \$299; 5MB SunDisk, \$395; 8MB RAM, \$499; 10MB SunDisk, \$595; cellular module, \$799; 20MB SunDisk, \$995.

Weight: 2.2 pounds.

Batteries: Uses one nickel cadmium battery. Average life of 4 hours.

CPU: Hobbit.

Display: 640 by 480 pixels, 110 dot-per-inch reflective LCD measuring 5.9 by 4.3 inches.

Operating system: GO Corp.'s PenPoint. Circle 456 on reader service card

► Fujitsu 325Point

Fujitsu Personal Systems Inc., 5200 Patrick Henry Dr., Santa Clara, CA 95054; 408-764-9443.

List price: \$2,295 with 4MB RAM.

Options: Fujitsu keyboard, \$95; 4- to 8-hour nickel hydride battery, \$110; off-line battery charger, \$125; external 3.5-inch floppy disk drive, \$350; 2,400-bps data/9,600-bps fax, \$350; 4MB JEIDA

expanded memory card, \$395; 1.8-inch 42MB hard disk, \$550; 8MB JEIDA expanded memory card, \$750.

Weight: 3.35 pounds.

Batteries: Uses one nickel cadmium battery. Average battery life of 2.9 to 7.6 hours.

CPU: 25-MHz AMD386SXLV.

Display: 640 by 480 pixels, 0.30-mm dot-pitch, 16-gray-scale backlit transreflective supertwist VGA LCD.

Operating system: GO Corp.'s PenPoint. Circle 457 on reader service card

► GRiD PalmPAD

AST Research Inc., 16215 Alton Pkwy., P.O. Box 57005, Irvine, CA 92619-7005; 714-727-4141.

List price: \$2,495 with 2MB RAM.

Weight: 2.9 pounds.

Batteries: Uses one nickel cadmium battery. Average life of 4 hours.

CPU: 9.54-MHz NEC V20.

Display: 640-by-400 CGA backlit transreflective LCD.

Operating system: DOS 5.0, PenRight! Circle 458 on reader service card

► Tandy Z-PDA

Tandy Corp., 700 One Tandy Center, Fort Worth, TX 76102; 817-390-3011.

List price: \$699 with 1MB RAM.

Options: AC adapter, extra pens, infrared interface, modem, PC Link software, PCMCIA SunDisk Flash ROM, PCMCIA SRAM card, serial cable, serial-parallel cable, pager. Prices unavailable at press time.

Weight: 1 pound.

Batteries: Uses three 1.5-volt or AA standard pen-size alkaline batteries. Average life of 100 hours.

CPU: Intel 8086-compatible processor by Casio.

Display: 320 by 256 pixels, 0.30-mm dot pitch reflective LCD measuring 3.15 inches by 3.94 inches. (4.75 inches diagonal).

Operating system: GeoWorks' GEOS. Circle 459 on reader service card

► Casio Z-7000 Personal Digital Assistant

Casio Inc., 570 Mt. Pleasant Ave., P.O. Box 7000, Dover, NJ 07801; 201-361-5400.

List price: \$899 with 1MB RAM.

Options: Infrared docking station, memory expansion cards, serial cable, serial-parallel cable, 2,400-bps modem, pager. Prices unavailable at press time.
Weight: 1 pound.

Batteries: Uses three 1.5-volt or AA standard pen-size alkaline batteries. Average life of 100 hours.

CPU: Intel 8086-compatible processor by Casio.

Display: 320 by 256 pixels, 0.30-mm dot-pitch reflective LCD measuring 3.15 inches by 3.94 inches.

Operating system: GeoWorks' GEOS. Circle 454 on reader service card

► Toshiba T100X Dynapad

Toshiba America Information Systems Inc., 9740 Irvine Blvd., Irvine, CA 92718; 800-999-4273, 714-583-3000.

List price: \$2,999 with 4MB RAM and 40MB hard disk.

Options: Security cable lock, \$55; holding stand, \$95; external 1.44MB, 3.5-inch floppy disk drive, \$249; 2,400-bps data/9,600-bps fax modem, \$339; proprietary 4MB memory card, \$429. 14.4-Kbps fax modem, \$499.

Weight: 3.3 pounds; 4.42 pounds with external charger; 6.13 pounds with carrying case.

Batteries: Uses one nickel hydride battery. Average life of 1.5 to 2 hours.

CPU: 25-MHz AMD386SXLU.

Display: 640 by 480 pixels, 0.30-mm dot pitch, supertwist transreflective backlit VGA LCD measuring 7.6 by 5.7 inches.

Operating system: Toshiba DOS 5.0 or GO Corp.'s PenPoint, Microsoft Windows for Pen Computing, AST Research's PenRight!

Circle 460 on reader service card

You can download or view photographs of some of these products in Library 2 (Features Hardware) of PC Magazine's Editorial Forum on ZiffNet. Search on the keyword "PDA."

equivalent of an Intel 8086—a 16-bit processor that works in real mode. The Tandy/Casio's 8086-like chip currently uses much less power than the Newton's or EO's processor, but it can't be pushed to operate much faster than it does already, and it's unable to address applications in protected mode. Thus, operations such as handwriting recognition and other processor-dependent operations are slow on the Tandy/Casio. A more powerful processor is needed to ensure the Tandy/Casio's future growth.

The Tandy/Casio's size and weight is very similar to the Newton's, but the two PDAs are as different as a Macintosh and a PC. The Tandy/Casio is targeted more at Tandy's consumer electronics customer, whereas the Newton is aimed primarily at businesses and vertical applications. The Tandy/Casio ships with many more applications than the Newton, including geographical and historical information databases, as well as a nutritional guide. The Tandy/Casio's battery life was much better than Newton's. But the Newton's handwriting recognition is far more accurate, and it handles cursive, unlike the Tandy/Casio. It's difficult to enter names and addresses in either PDA, but it is easier in the Newton.

When it comes to case design and fit-and-finish, the Newton has it all over the Tandy/Casio. The Tandy/Casio has a flip-over screen cover and the Newton doesn't, but the pen and ports on the Newton look better made. And while many of the Tandy/Casio's controls are external, the Newton's contrast and volume controls are adjustable on-screen.

Most of the Tandy/Casio's applications are useful, but the tiny pen is hard to use, and the Tandy/Casio can't yet connect to a desktop PC. Accessing America Online requires a Hayes-compatible modem, cable, and phone line, or just a PCMCIA modem.

Over the next year, more applications will become available, and Tandy and Casio will establish desktop links making it easier to copy information to and from the Tandy/Casio. And PCMCIA wireless options should appear in one to two years. But until then, the Tandy/Casio must be thought of as an expensive novelty.

Toshiba America Information Systems Inc.

Toshiba T100X Dynapad

BY DON CRABB

The Toshiba T100X Dynapad is Toshiba's first hand-held, pen-based computer. It weighs 3.3 pounds and comes with 4MB of RAM (expandable to 20MB), a fairly fast 40MB IDE hard disk, two PCMCIA Type II sockets, and a Toshiba proprietary credit card-style port for memory expansion.

The Dynapad's backlit transreflective supertwist VGA LCD screen (9.5 inches diagonal) occupies most of the top of the unit's 10.5- by 8.25- by 1.5-inch case. The Dynapad uses a low-voltage (3.3 volt) 25-MHz AMD 386SXLV microprocessor and comes configured with either Microsoft Windows for Pen Computing or GO Corp.'s PenPoint pen-based interface. Our test unit came configured with Pen Windows.

The Dynapad is not a PDA. It is too heavy and large, and is unequipped with either a personal organizer or wireless communications. The Dynapad resembles an electronic clipboard, and can be used for vertical pen-based solutions. Toshiba is also trying to create an entirely new mobile market, one comprising people who need a notebook computer but want a pen interface and handwriting recognition rather than a keyboard.

We found that you need the optional keyboard to get much real work done with this unit. The Dynapad garnered only fair scores on most of our general-use tests (communications, everyday pen use, field use, form completions, handwriting recognition, and notetaking).

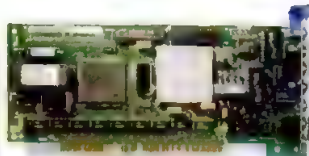


The Dynapad is a 3.3-pound pen tablet with two PCMCIA slots.

a) Token-Ring



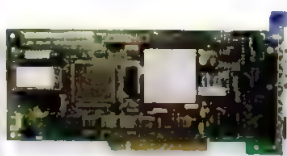
*Token-Ring 16/4
Adapter/A (MCA)*



*LANStreamr MC 32
Adapter*



16/4 ISA 16 Adapter

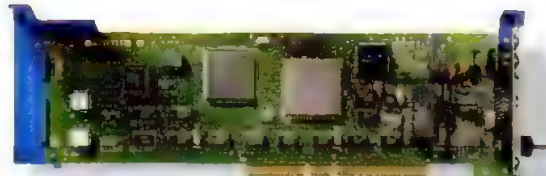


*LANStreamr MC 16
Adapter*

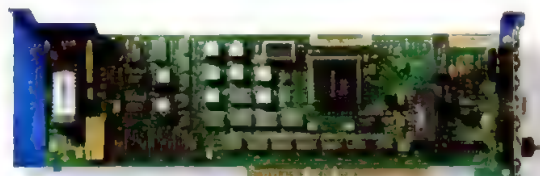


*16/4 Busmaster EISA
Adapter*

b) Ethernet



*EtherStreamr MC 32 Adapter
(10BaseT/2/5, full duplex mode)*



LAN Adapter/A for Ethernet (10BaseT/2/5, MCA)



*LAN Adapter for Ethernet
TP (10BaseT, ISA)*



*LAN Adapter for Ethernet
CX (10Base2, ISA)*

e) All of them

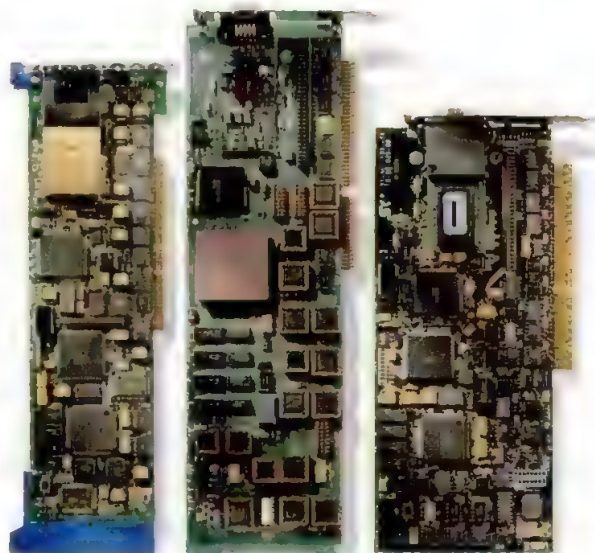
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c) FDDI



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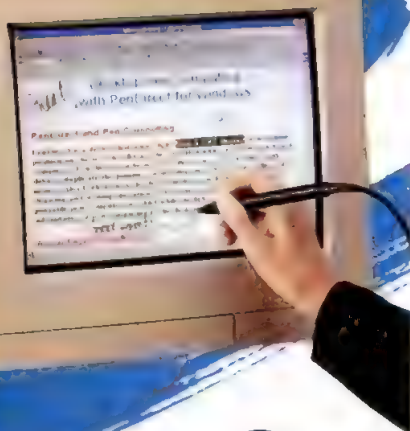
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COVER STORY

PDA's

SUITABILITY TO TASK

Toshiba T100X Dynapad

	POOR	FAIR	GOOD	EXCELLENT
Daytimer	●	●	○	○
Communications	●	●	○	○
Custom applications	●	●	●	○
Handwriting recognition	●	●	○	○
Mobility	●	●	●	○

with the exception of our file-management test, on which it performed well.

Like the NEC VersaPad, the Dynapad uses a CalComp digitizer with an active pen, which uses four button batteries and fits into a handy, built-in holder. Although the pen worked well as a mouse substitute, using it to input information was frustrating.

Handwriting recognition under the Pen Windows operating system is poor. Users must print letters carefully and in lowercase to get it to work at all, and cutting and pasting within documents is excruciatingly slow.

The Dynapad's dimensions make it manageable, and the unit is ruggedized for use in the field. It can work with LapLink and similar products for exchanging files with a desktop PC, and an external floppy disk is an option.

The Dynapad's nickel hydride battery pack is among the smallest and lightest available—about the size of a pack of cigarettes. Battery life is maximized by incorporating a number of power-management features, including automatic screen and hard disk shutdown. Toshiba claims a worst-case battery life of 2.5 hours. But the battery pack we tested lasted only 1 hour 25 minutes. Recharging the batteries takes 3 hours, and there is no way to speed up this process. The Dynapad's battery management would be considered disappointing for a PDA.

With the keyboard, the Dynapad could serve as a notebook machine—albeit a cumbersome one. As a communicator, it compares well to standard 386-based Toshiba notebooks with fax modems. It comes up short when compared with the Newton and the other PDA's, which also offer more advanced communications options. □



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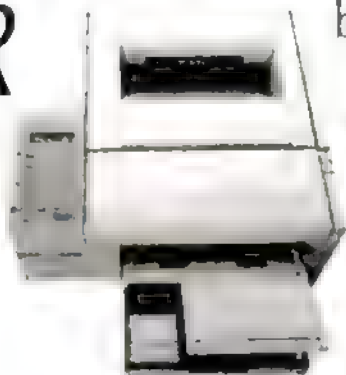
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IMAGE- EDITING SOFTWARE

Has The Mac Met Its Match?



The final composite test image was created by Maureen Jones in Adobe Photoshop, then output as color separations.

by Gayle C. Ebrenman

A year ago, we began our image-editing review by asking whether the PC could replace the traditional photo darkroom when it came to image editing. With victory over the darkroom pretty well established, this year we turn our attention to other challenges. We take on the Macintosh—the heretofore undisputed champ of PC-based image editing.

When it comes to image editing—that is, the digital manipulation of photographic-quality images on the PC—there's little these days that the Macintosh can offer that the PC can't match, and probably for less money, too. Certainly when it comes to hardware power and performance, the PC can more than equal the Macintosh, while leaving more pennies in your pocket. The minimum system required to adequately work with images on a PC is a 386/33 with 4MB of RAM, a 24-bit graphics adapter, and a color monitor, which will cost you under \$1,500. The same sort of horsepower on the Mac platform, in the form of a Macintosh IIfx, will cost \$2,000. And thanks to the rapid evolution of PC hardware and the availability of Pentium-based PCs, that

The PC no longer needs to play stepsister to the Macintosh.

IN THIS REVIEW

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Image-Editing Software

gap won't get any narrower until the release of the PowerPC.

In the past, the Mac has held the lead in image-editing software. Adobe Photoshop for the Macintosh made all PC-based image-editing software pale by comparison. Now the tide has turned. Photoshop, which, along with Fractal Design Corp.'s ColorStudio, pioneered the field of electronic image editing, has now made its way over to the Windows environment. The Windows package has everything the Mac package has always offered production professionals except some of the third-party add-ons. But it's only a matter of time until these are also available on the PC platform. (For more on the Macintosh version, see "The Photoshop Culture: A Look at the Mac Leader.")

The PC also offers a far greater selection of image-editing tools that appeal to a far more varied audience. Image editing on the PC is clearly a two-tiered market, with products for the high-end professional user as well as for the casual busi-

ness user. While Adobe Photoshop and Micrografx's Picture Publisher push the envelope with advanced features such as color separation, CMYK editing, and the ability to work on very large files, ImageWare Software's ImageWizard and Micrografx's PhotoMagic for Windows break new ground in ease of use for mere mortals. These business-use packages are surprisingly rich in features, including the ability to layer objects.

The PC marketplace hasn't just been keeping pace with the Macintosh environment—it's been developing by leaps and bounds. The last time we visited this category ("True Color Image Editing: Darkroom R.I.P.?", September 29, 1992), we looked at eight packages; this year there are nine, with several others waiting in the wings. Besides the recently converted Photoshop, the new entrants include ImageWizard, PhotoMagic, and Ventura PicturePro, from Ventura Software. All of the returnees from our last roundup appear in new and in many cases substantially different versions. These

new, improved packages are: Image-In-Color and Image-In-Color Professional from Image-In; PhotoFinish, from WordStar Atlanta Technology Center (formerly ZSoft Corp.); and Picture Publisher from Micrografx.

WinRIX, from RIX SoftWorks, which couldn't survive the rigors of our testing last time around, proved to be a much more robust package this outing. Aldus PhotoStyler was in the midst of a major revamping at the time of this review; the next release should be available by the time you read this. Altamira Composer, perhaps the most unusual of the image-editing packages to debut since we last looked at this category, was also in beta as we went to print, but it should be in a software store near you at this time. (You can read more about these two packages in "Composer and PhotoStyler.")

To be included in this review, a product had to be a dedicated image-editing package able to work with 24-bit color images, have direct support for a stan-

Suitability to Task:

Image Editors

The nine packages in this review are all intended to do essentially the same things: repair and improve scanned-in photos. They break down into two categories, however: high-end professional-level image editors and business-level image editors. Depending on what you need an image-editing package for, a product from either group may meet your needs.

We evaluated each package by five sets of criteria to determine which category it belongs in—professional- or business-level—and how well it performs on a variety of tasks.

Photo retouching lies at the heart of all image-editing tasks. To excel in this category, a product must offer good scanner drivers (at the very least, a reliable, functional Twain driver); flexible tonal adjustment capabilities for enhancing the highlight, midtone, and shadow of an image; and effective global filters such as despeckle and sharpen. The package must also offer a useful, basic set of selection tools that allow you to specify carefully the area of a photo you want to change. Finally, it should offer access to attractive fonts for annotating your photo.

SUITABILITY TO TASK				
Product Name	POOR	FAIR	GOOD	EXCELLENT
Photo retouching	●	○	○	○
Creative editing	●	●	○	○
Professional imaging	●	●	●	○
Output	●	●	●	●
Image management	N/A			

N/A—Not applicable: The product does not perform this task.

For **creative editing**, a package must offer, at the least, the tools needed for photo retouching. Beyond the basic assortment of selection tools, a package needs to offer area- and color-masking capabilities, a well-chosen set of special-effects filters, and a robust set of painting tools.

In **professional editing**, we're looking at those extras that separate the business-level packages from the professional-level powerhouses. To fare well in this category, a package must offer the capabilities an imaging professional requires, including the ability to perform more than just eyeball calibration on the monitor, printer, and scanner; to work with multiple, high-resolution images; and to separate an image into its CMYK channels (the ability to edit in CMYK color

space is greatly preferred). In addition, professional-level packages should allow you to work in a separate mask channel and save paths, masks, and PostScript outlines, and to produce color separations.

Output encompasses a package's ability to produce both printed and electronic output and the attractiveness of that output. When it comes to printed output, a package should be able to print quickly, easily, and accurately to your chosen output device, be it a black-and-white LaserJet printer or a PostScript-compatible image-setter. Quality and flexibility are what count here. The key to success at electronic output is the ability to create an attractive image that will be viewed only on-screen, perhaps as part of an electronic slide presentation. Important considerations include the ability to resample an image down to a lower resolution, to compress images, and to perform palette optimization and color reduction (say, from 16.8 million colors to 256 or from color to halftone).

Image management encompasses all the extras that make moving, renaming, and generally controlling your image files easy. Some of these extras include image thumbnails and albums; the ability to catalog, archive, and delete files; and the ability to obtain information easily about the image you're working on. The ability to import and export images in a variety of file formats is also a key consideration.



EDITORS' CHOICE

dard array of desktop scanners, offer masking tools and special-effects filters, and have undergone revision since the last time we reviewed it. PixaFoto, from PixaArts Corp., was not included because it hadn't changed since our last review. Image Assistant for Windows, from Caere Corp., did not support our input device, and it exhibited some known memory problems that should be corrected by a new version that was in beta at test time.

BREAKING THE BOTTLENECKS

This time around, the field of image editing is marked by more than just new products. There are new approaches, too—ones that tackle large, complex, and sometimes unruly images.

While you may need to have a 20MB image displayed on-screen, chances are you only need to work on a small portion of it at any given time. To cut down on memory- and time-intensive procedures like zooming and screen redraws, some packages, such as Picture Publisher, add ways for you to edit a lower-resolution, smaller-file-size version of your high-resolution behemoth of an image. Whatever changes you make can be recorded as a macro to be applied to your high-resolution image. If you must edit the high-resolution version, you can choose Picture Publisher's FastBits option, which allows you to choose only a portion of a larger image to edit.

Making adjustments to an entire image, be it a global filter change or a remapped color value, is another bottleneck. Part of the problem stems from not knowing exactly what you'll get when you increase the amount of, say, red in an image, and the rest of it stems from waiting for the PC to recalculate the necessary values and then to redraw the altered image. To take some of the guesswork out of the alteration process, several packages, including PhotoMagic and Picture Publisher, offer preview thumbnails for image adjustments and filters. Push one of those adjustment sliders and you can quickly see the change on the thumbnail; if you like what you see, choose Apply and the image is updated.

More dramatic than either of these time savers is the new object-oriented approach that's spreading throughout the

- **Adobe Photoshop for Windows, Version 2.5**
- **PhotoMagic for Windows, Version 1.0**

It's a rare product that distinguishes itself in its first version, but such is the case with both of our Editors' Choice winners. Adobe Photoshop (\$895) may carry a 2.5 version number, but this release marks the first appearance of the Macintosh stalwart on the Win-

dows platform. And though Micrografx's PhotoMagic for Windows (\$149) carries a 1.0 version number, it's as polished as any seasoned veteran.

Whereas Photoshop caters to the professional market, PhotoMagic targets the business user. Both packages do an admirable job of meeting the needs of their intended users.

Photoshop's powerful filters, precision selection tools, and customizable paintbrushes give prepress and photography professionals the tools they need for intensive image-editing tasks such as creating composite images and editing directly in CMYK.

Part of what sets Photoshop apart from the rest of the image-editing pack are its abilities to create and save eight-bit selections and to save these selection areas as reusable masks—or alpha channels—attached to a particular image; and each Photoshop image can contain up to 16 of these eight-bit channels. The package's superior image-enhancement filters, color separation capabilities, and wealth of file-conversion options make your image-production tasks easy. Beginners beware, however: This package may be powerful and flexible, but it's not easy to learn.

PhotoMagic, on the other hand, offers a truly elegant, easy-to-master interface and a strong set of basic image-editing tools perfect for the business user who needs to retouch some photos or manipulate images before exporting them to a desktop publishing application. Ease-of-use features such as the thumbnail-based ImageBrowser and

EffectsBrowser go a long way toward helping business users track and manipulate their images.

A full array of selection tools and a wider selection of draw and paint tools than can be found in many professional-level packages, including natural-media brush styles and a colorizer tool, make it easy to go from business user to creative artist with a few mouse clicks.

Honorable mentions go to Micrografx's Picture Publisher (\$595) and to ImageWare's ImageWizard (\$199), which bring object-oriented image editing to professionals and business users, respectively. Picture Publisher offers many of the same ease-of-use features as its business-level sibling, while giving professional users the powerful masking and color handling they require. Its object-oriented approach allows you to treat parts of your bitmap image as separate floating selections, making it easy to perfect composite images. Its only shortcomings are an incomplete implementation of Bezier tools and some limitations in working with CMYK files.

While ImageWizard gives business users a strong set of masking and paint tools, it's most notable for its use of objects: Everything but the background of an image is treated as a separate object here. The package is a bit weak on color handling and lacks some of the standard effects—such as a motion blur filter—that you'd expect to find in an image-editing package.

GRAPHICS

Image-Editing Software

world of image editing. Taking a page from vector-based graphics, the object-oriented approach allows you to treat pieces of your bitmap graphic as floating objects that can be moved around infinitely and stored for use in other images.

In some packages, such as Ventura PicturePro and Image-Wizard, once you stick an object down, you're pretty much stuck with it. In Altamira Composer, however, an object remains independent of everything else in the image until you choose to print it. The PainterX2 expert extensions (\$149) to Fractal Design Painter go one step further: The objects remain independent and fully editable even after you save and close a file.

This vector-type capability cropping up in bitmap graphics packages points to another trend—the convergence of paint, image-editing, and illustration software packages. While a package such as Fractal Design Painter possesses many of the same capabilities as the image-editing packages included in this review, its primary use is for creating natural media paintings. CorelDRAW, on the other hand, began as a vector-based illustration package, but has grown to incorporate a series of task-specific modules, including Corel Photo-Paint!, which is something of a hybrid image-editing/paint package. One of the dedicated image-editing packages in this review, RIX SoftWorks' Win-RIX, offers almost as much in the way

of vector-based drawing as it does bitmap editing tools.

WHERE WILL IT ALL END?

As 24-bit graphics and photo-realistic images become more a part of our workaday computing lives, image-editing software will become more of a mainstream tool. Finally mature, the market is breaking down into two tiers: the professional and the business. At the professional level, you'll find packages like Photoshop, PhotoStyler, and Picture Publisher. The much

more crowded business level includes Image-In-Color, PhotoFinish, and Photo-Magic for Windows among its ranks.

Despite what a package may call itself, what sets it firmly in one category or the other is functionality. Business-level packages should make it easy to do the things business users require, such as palette optimization and simple retouching.

Professional-level packages require a far more complex set of tools. Here, the emphasis is on flexibility. Where business-level packages need only work in RGB color space and provide a basic selection of masking tools, professional-level packages must let you edit images directly in CMYK color space, handle large images efficiently, and give you sophisticated masking capabilities.

Keep in mind, though, that all of this power comes at a price. Professional-level packages cost anywhere from \$300 to \$700 more than their business-level siblings, and they are far more difficult to learn. If you need the sophisticated tools they offer, they're a great investment. But if all you need to do is clean up some photos for your newsletter, you're better off choosing one of the less expensive, easier-to-master business-level packages. Read the reviews and study the Summary of Features table to determine which package best suits your needs. Regardless of which package you choose, one thing is certain: The key to more attractive images lies within your reach—and within your PC.

The object-oriented approach allows you to treat pieces of a bitmap graphic as floating objects that can be moved and stored.

Our Contributors: JOHN MOORE is a staff editor and OLIVER RIST is a staff writer of *PC Magazine*. LUISA SIMONE is a contributing editor to *PC Magazine*. LORI GRUNIN and ANGELA GUNN are frequent contributors to *PC Magazine*. DON LABRIOLA is an independent consultant. MARLA MILNE is a graphic artist who created the composite image used in the PC Labs tests. MAUREEN JONES and PAULINE ORES are free-lance writers. GAYLE C. EHRENMAN was the associate editor in charge of this story, and JEFF MACE was the project leader.

Adobe Systems Inc.

Adobe Photoshop for Windows

BY LUISA SIMONE AND MAUREEN JONES

Adobe Photoshop (along with ColorStudio, now distributed by Fractal Design Corp.) revolutionized digital pre-press on the Macintosh. Photoshop's powerful filters, precision selection tools, and customizable paint brushes literally defined image processing on the desktop. Now this \$895 professional-level program is available to Windows users. So similar are the Mac and PC versions of

SUITABILITY TO TASK

Adobe Photoshop for Windows

	POOR	FAIR	GOOD	EXCELLENT
Photo retouching	●	●	●	●
Creative editing	●	●	●	●
Professional imaging	●	●	●	●
Output	●	●	●	●
Image management	N/A			

Photoshop that users can switch between the two environments without losing a beat or compromising their aesthetic standards.

Photoshop's roots are firmly planted in the world of traditional pre-press shops and photography studios. For example, users are expected to be familiar with specialized terminology (such as dodge and burn) and difficult concepts (such as gamma correction and under color removal). These tools and functions inspire confidence in professional users, but are undeniably intimidating for novices.

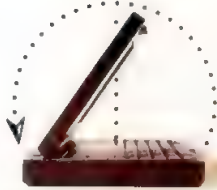
One of the true tests of an image-editing program is the flexibility of its selection tools. A brief tour of Photoshop's toolbox reveals standard rectangular, elliptical, and freeform (a.k.a. lasso) marquee as well as the now-famous magic wand. But the deeper you dig into the program, the more selection options you discover. While most programs offer a feather option to soften—or antialias—the edges of a selection area, only Photoshop includes a Defringe command to remove the soft edges of an antialiased image. This is a subtle but invaluable fea-

 **It sits,
lies down,
and does
back
flips.**

Good b



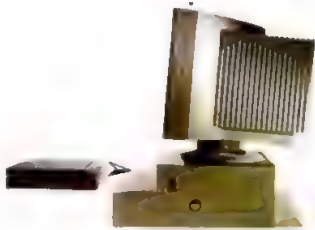
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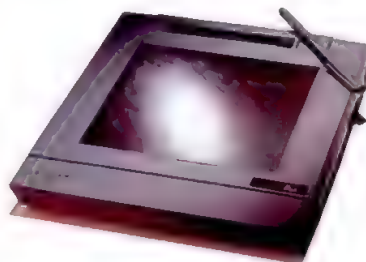
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Image-Editing Software

ture that results in a cleaner picture when you paste an antialiased selection into a new background. For example, during testing in PC Magazine Labs, the Defringe command quickly cleaned up the not-quite-black pixels that marred the outline of the Guy.TIF image and his attache case in our composite image.

Photoshop's selection areas utilize eight bits of data, which means that they can create not only feathered edges but 256 levels of opacity/transparency. Moreover, you can save a selection area as a reusable mask—or alpha channel—attached to the current image. For example, it was easy to make the daytime sky merge gradually into the nighttime sky in our test image by using a gradient-filled eight-bit alpha channel to mediate the paste operation. Unlike other programs, which force you to save eight-bit masks as an external file, each Photoshop image can contain up to 16 eight-bit channels, all of which are controlled internally through the Channels palette. Typically, the primary image data will occupy three (for RGB) or four (for CMYK) channels, leaving 12 or 13 alpha channels available for image-editing masks.

WORKING WITH VECTORS

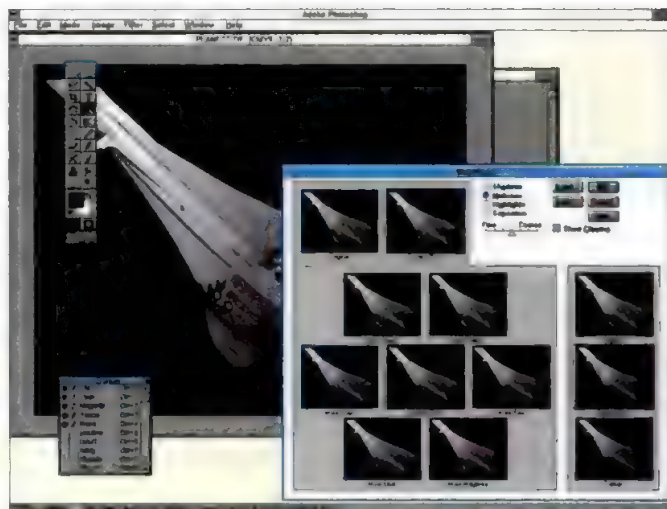
One of Photoshop's most unique features is its ability to utilize vector—in addition

to raster—information. Using the Bezier drawing tool, found on the Paths palette, you can draw and edit freeform curves. This allows you to develop outlines with the precision normally found only in object-oriented drawing programs (like Adobe Illustrator). Once you have created a path, you can stroke it (drawing a perfectly smooth line), fill it (creating a freeform shape), or convert it into a selection area or mask.

Photoshop can also export and import vector curves in the form of editable Encapsulated PostScript (EPS) files. This feature was especially useful when we added the text phrase "Time is Money" to the test image. Of course, Photoshop can directly access, scale, and antialias any Type 1 or TrueType font installed under Microsoft Windows, but its text-manipulation functions are limited to simple formatting options such as leading, alignment, and boldfacing. Therefore, it was far more efficient to align the text to a curve within Adobe Illustrator and then to import the final design into Photoshop as a mask.

The PC Labs test suite provided a number of opportunities in which to employ Photoshop's filters, which run the gamut from production tools to special effects. For example, enhancing the daylight sky required us to use both the brightness and color balance filters. We easily created the accelerating plane by using the motion blur filter.

We were especially impressed with the hard-working, always reliable image-enhancement filters. The ability to set the highlight and shadow points, for example, mimics traditional pre-press techniques and consistently produces images with a wide dynamic range. And just about every image-editing filter comes complete with a Preview option, taking much of the guesswork out of fine-tuning



Photoshop's flexibility includes detailed previews of hue and saturation adjustments.

the tonal and color values in a picture. If the idea of previews appeals to you, you'll love the new Variations dialog box, where you can view thumbnails with different color, saturation, and brightness levels. Just click on the preview that looks right and the program makes the changes automatically.

Though the 40-plus special-effects filters all worked as advertised, we found some room for improvement here. Although the Undo command is available to reverse a special effect, we'd prefer if the program offered a preview option as well. In addition, our large images generated some memory problems, because several of the more computationally intensive effects (notably the Distort filters) must be executed entirely in RAM—no virtual memory allowed. The software's average speed for performing a motion blur on our 64MB test-bed was 43.73 seconds, compared with 103.03 seconds on our 16MB machine. In fairness to Adobe, Photoshop had no trouble applying these same filters to smaller images or to selected areas of a larger image that fit within the 16MB of RAM installed on our test-bed machine.

Photoshop has cloning and editing tools that made short work of retouching a damaged gray-scale photograph. For example, the clone tool—especially with the nonaligned and antialiasing options—did a superb job of repairing several large scratches on the original image by allowing us to copy clumps of

FACT FILE

Adobe Photoshop for Windows, Version 2.5

Adobe Systems Inc., 1585 Charleston Rd., Mountain View, CA 94039; 800-833-6687, 415-961-4400; fax, 415-562-6775

List price: \$895.

Requires: 386-based PC or better, 4MB RAM (16MB recommended), 40MB hard disk space (200MB recommended), 256-color display (24-bit accelerated graphics display recommended), DOS 5.0, Microsoft Windows 3.1, mouse. (A Microsoft Pen Windows-compatible pressure-sensitive digitizing tablet is recommended.)

In short: Photoshop now reigns supreme among image-editing packages for the PC. Its variety of paint tools and support for pressure-sensitive digitizing tablets will spark your creativity. Its impeccable color-separation and file-conversion capabilities make Photoshop a must-buy for image-editing professionals.



ON READER SERVICE CARD

Image-Editing Software

leaves and maintain a naturally random look with ease. Likewise, we took complete advantage of Photoshop's ability to flip, rotate, skew, and add perspective to a selection area in order to patch a section of the sidewalk.

A WHIZ AT COLOR

It is all too easy to overlook one of Photoshop's most powerful image-editing features—the ability to alter images using different color models, such as RGB, CYMK, or L*a*b*. So if you use a 32-bit scanner to generate CYMK files directly, you don't have to lose information and convert the image to 24-bit RGB files. Likewise, working with L*a*b* (a device-independent color model developed by the Centre Internationale d'Eclairage) enables you to transfer images from platform to platform or to different output devices and suffer only

a minimum of color shift.

For those artists who prefer to create pictures from scratch, Adobe Photoshop offers robust and customizable painting tools. For example, you can determine

the size and shape of the brush, set transparency and antialiasing levels, or choose how the brush will respond to a pressure-sensitive stylus. You can even configure the paintbrush to fade out in the same way that a real brush would run out of ink.

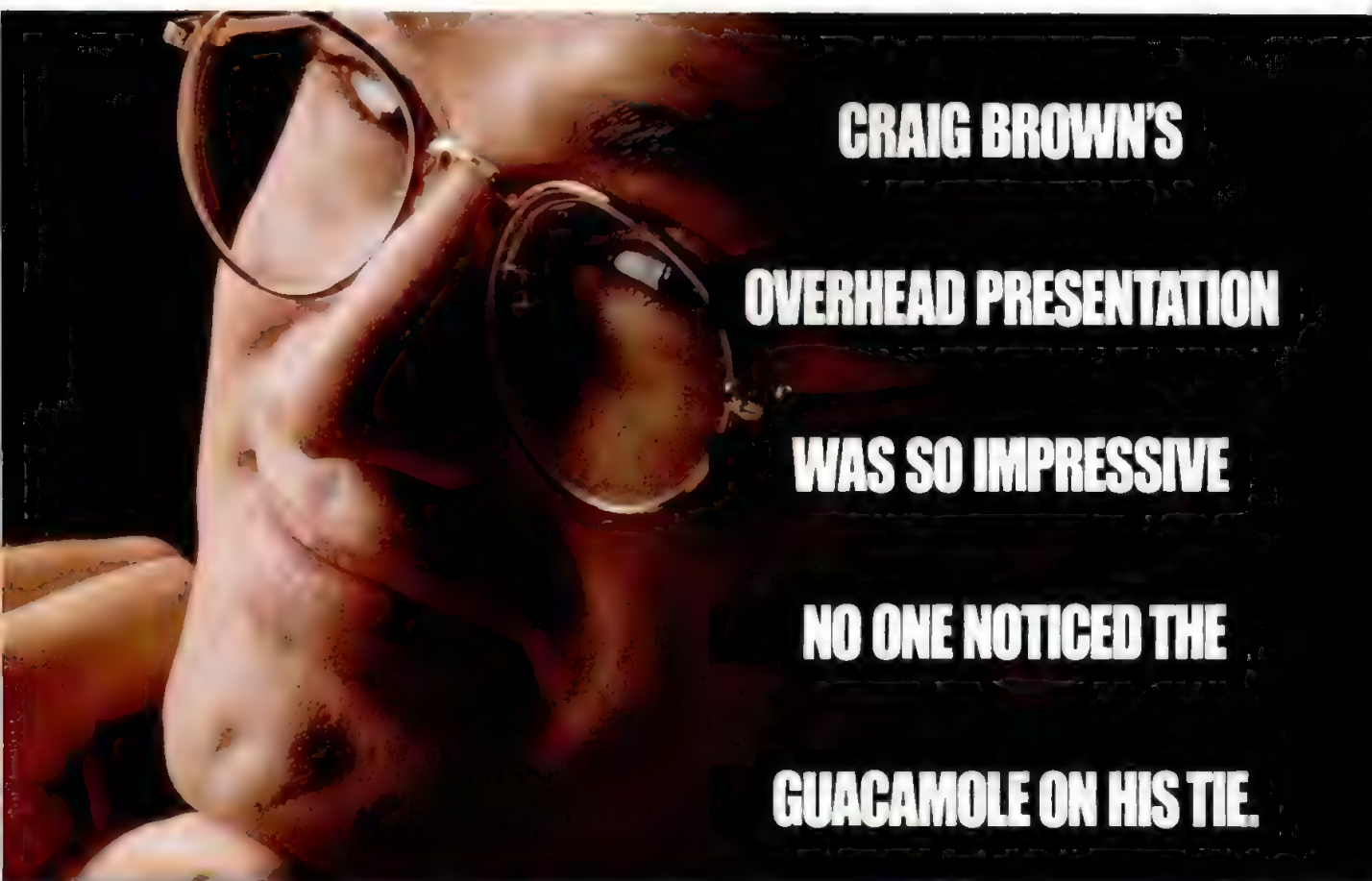
When it comes time to export your

images for use in other applications, you'll discover that, once again, Photoshop provides you with lots and lots of options. The wide range of supported file formats includes standards such as BMP, EPS, and TIFF, as well as high-end and emerging formats such as JPEG, Pixar, and Targa.

Equally important, Photoshop also allows you to optimize images for specific applications, allowing desktop publishers to customize the GCR (Gray Component Replacement) and UCR (Under Color Removal) maps used for process separations. Television producers can employ the National Television Standards Committee's Colors filter to generate an image that falls safely within the gamut of broadcast video. Multimedia authors and animators can choose from seven different bit depths, four palette-generation techniques, and three different dither patterns when they convert full-color pictures into the indexed color files required by most presentation and animation programs.

Photoshop ships with a small selection of plug-in utilities that, for the most part, supply basic functions. Both the Twain scanning module and the JPEG import filter, for example, are implemented as plug-ins. But you can expect to see a host of add-in products that address the needs of high-volume pre-press shops and professional artists.

*We took complete
advantage of
Photoshop's ability to
flip, rotate, skew, and
add perspective to a
selection area.*



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OVERHEAD PRESENTATION

WAS SO IMPRESSIVE

NO ONE NOTICED THE

GUACAMOLE ON HIS TIE.

Image-Editing Software

Two features that are notably absent and sorely missed from Photoshop are an image-management utility and a macro recorder. Right now, you must rely on the all-too-limited eight-character DOS filename in order to locate and identify your images, because Photoshop does not supply a thumbnail preview, an image browser, or a file-search function. And unfortunately, the only way to repeat complex image-editing sequences is to take detailed notes, because Photoshop does not offer macro record and playback functions.

Despite these few caveats, there is only one way in which to describe Adobe Photoshop for Windows: It is an image-editing dynamo. With its superior image-enhancement filters, color-separation capabilities, and file-conversion options, Adobe Photoshop can easily become the engine that drives your production system. At the same time, its customizable painting tools, endlessly malleable masks, and support of pressure-sensitive digitizing tablets can energize your artistic imagination.

Image-In Inc.

Image-In-Color

Image-In-Color Professional

BY JOHN MOORE

Sometimes less is indeed more. Both the \$495 Image-In-Color and its higher-priced twin, the \$795 Image-In-Color Professional (both Version 3.1a), provide flexibility and ease of use. Provided that you don't want to do anything too extravagant, either package is up to the task. But the business-level product surpasses its professional-level sibling in terms of appropriateness. In many ways, Professional is a product that hasn't kept up with the increasing demands of users or with the capabilities of its competitors.

For the most part, Image-In-Color can do everything Professional can do when it comes to basic photo retouching. The biggest differences are that Image-In-Color cannot adequately handle multiple images, and it offers fewer tool options

and special-effects filters than Professional. Nor can Image-In-Color handle CMYK images: When we tried to open one of the images used to create our CMYK composite test from a Syquest drive, we received a "formatted with unsupported feature" warning and had to open the file in RGB mode. But since both packages share base capabilities, we were able to work in Image-In-Color until we reached the professional color-production task in our test.

Both products share identical interfaces, with a status line at the bottom and a handy progression meter that simulates

SUITABILITY TO TASK				
Image-In-Color				
	POOR	FAIR	GOOD	EXCELLENT
Photo retouching	●	●	●	○
Creative editing	●	●	●	○
Professional imaging	N/A			
Output	●	●	○	○
Image management	●	●	○	○



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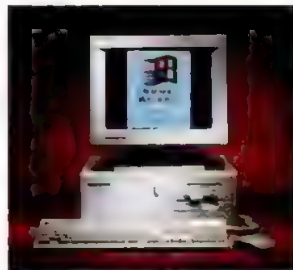
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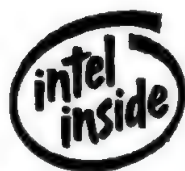


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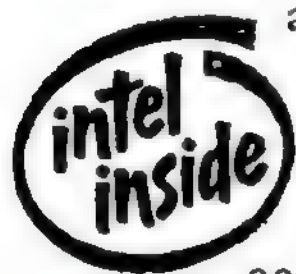


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PC/Computing, July 1993.

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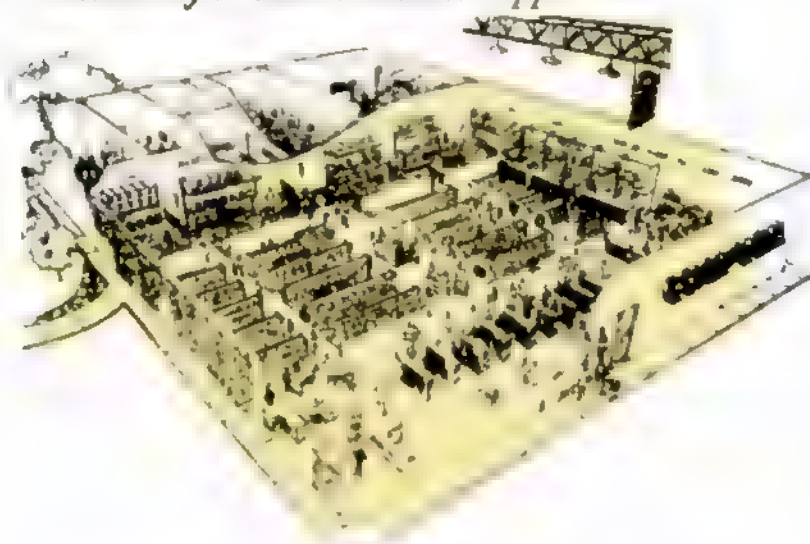
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Image-Editing Software

an LED when loading or processing an image. Both offer toolboxes containing most of the basics, including a magnifier, airbrush, gradient fill, and Bezier curve tool (though this only offers minimal flexibility). Dialog boxes for most of the tools can be accessed by simply clicking the right mouse button.

Neither package allows you to color-calibrate your monitor. Both allow you to calibrate your scanner with your printer, however. The lack of monitor calibration is merely an annoyance in a business-level package, but it is inexcusable in a professional-level package.

PHOTO-RETOUCHING FINESSE

What's most impressive about both packages is their photo-retouching capabilities. Repairing the damaged photo in our test was a breeze, thanks to the clone tool (called Stamp) common to both packages. The user can adjust the size and shape of the pixels and the pressure of the Stamp tool, while Professional allows you to adjust the spacing, fadeout, and paint control as well. The zoom tool allows you to magnify the image up to 16 times its normal size, enabling you to retouch images with extreme detail, even at the individual-pixel level. In order to brighten up the image, we adjusted the contrast and brightness and removed all hue and saturation, all of which can be previewed, undone, and redone.

Palette editing is straightforward enough: Simply double-clicking on the color you want to change brings up the Set Foreground/Background dialog box in which you can change the HSV values (Professional also allows you to adjust the RGB values).

STRANGE SITUATION

Although the interface shared by the two programs is flexible enough for a novice to learn basic functions quickly, we found some areas in which the organization was strange, at best. For example, in Professional, you create a mask by choosing the Selection To Image command from the

Edit menu, not the Image menu. Masks are added to active images by choosing Image To Selection. Once you figure this out, you then discover that these gray-scale selections cannot be saved to a true alpha channel.

The user manual is not much help; documentation of features for both products is condensed into one manual, organized by menu commands, and we had to call tech support for features that were not clearly detailed in the manual. The manual won't tell you that Professional ships with Twain scanner support: A sticker attached to the inside of the addendum to the manual includes this detail.

Because of the poor documentation, and because both Image-In products include only a rudimentary tutorial, using masking functions was more difficult to figure out than it needed to be. In order to merge the blurred plane with the sharp version in our CMYK test image, we had to create a graduated mask of the plane, use that image to select the plane itself, and then paste it onto the image. This course was selected after several attempts at finding the method that worked best. What should be a relatively simple task in a professional-level package is an exercise in patience with Image-In Color Professional.

Things didn't get much better when Professional could not open our DKWATCH.TIF file from Syquest. We had to open an RGB version of the image in order to complete our composite test image.

Image-In states that the optimal con-

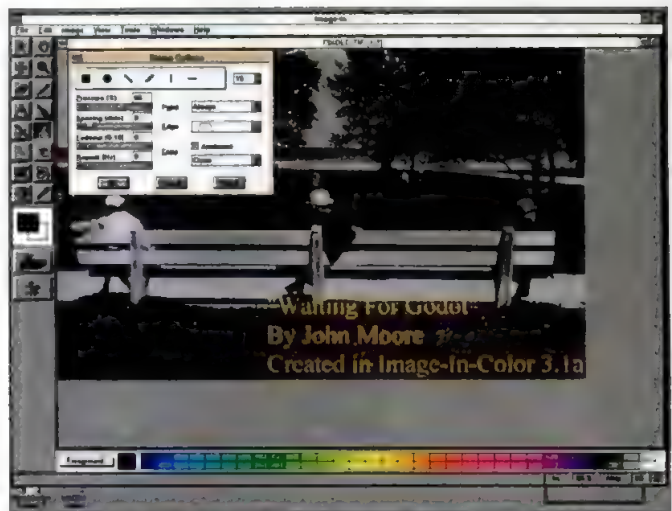


Image-In-Color's wide range of tool options provides business users with sufficient creative control of their images.

figuration for Professional is a 486 machine with 16MB of RAM, a 200MB hard disk, a read/write optical disk, and a pressure-sensitive tablet. But on PC Magazine Labs' 16MB test-bed, pasting and redrawing the CMYK test image was excruciatingly slow. Both packages, however, showed surprising speed on our performance tests. Image-In-Color completed an arbitrary rotate in an average of 102.03 seconds on our 64MB test-bed, and in 282.01 seconds on our 16MB machine. Professional was slightly faster on the 64MB test-bed at 101.24 seconds, but actually lagged behind its less powerful sibling with a 291.05 average on the 16MB machine.

LIMITED TYPE HANDLING

Image-In-Color Professional allows you to add text in a variety of styles and typefaces, but it provides no easy means to individually size, kern, or adjust the angles of characters. Moreover, there was no reasonable means of creating and applying the rainbow effect to each of the letters in our test image. Professional also couldn't import text in vector formats, which would have allowed us to achieve the desired effect.

Even more disappointing is Professional's lack of a send-to-back command, something you'd expect in a professional-level package. In order to place the text behind the man in our CMYK image, we would have had to create a mask of the man, copy it, place the text over the se-

SUITABILITY TO TASK				
Image-In-Color Professional				
	POOR	FAIR	GOOD	EXCELLENT
Photo retouching	●	●	●	○
Creative editing	●	●	○	○
Professional imaging	●	●	○	○
Output	●	●	○	○
Image management	●	●	○	○

■ The Photoshop Culture: *A Look at the Mac Leader*

by Pauline Ores

Until recently, image editing had been the sole province of the Macintosh. The rapid evolution of PC hardware, however, has helped narrow the gap between the two platforms. And now that Adobe Systems has released Adobe Photoshop for Windows, Version 2.5, the boundaries have become completely blurred.

Yes, there are differences between the operating systems and hardware, but the differences between the two platform-specific versions of Photoshop are hardly enough to write about. Running Photoshop on a Mac does offer some inherent advantages, however: Mac files have both a data and a resource fork, and the latter can store information about a file as well as a PICT preview. Many programs can take advantage of this feature to display minipreviews of image files in the "Open" dialog window.

While it's generally accepted that a 486 DX2/66 chip is faster than the Mac's 40-MHz 68040, that doesn't mean that Photoshop will be faster at all operations on the PC. The Mac's System 7, Version 7.1, is a 32-bit environment capable of benefiting from running 32-bit compiled apps such as Photoshop. Since Photoshop for Windows is a 16-bit app, mathematical operations like bicubic interpolation that take place when you rotate, resize, or cause the image to be reconstructed are slower on the PC. However, applying filters like Gaussian Blur, if performed in memory on a PC—or on a PC with a fast disk subsystem—may be as much as 20 percent faster than they are on the Mac.

The two platform-specific versions are in lockstep development and can share binary files—a real improvement

over the leapfrog development method used for Adobe Illustrator, where Version 4.0 is only for the PC and Version 5.0 is only for the Mac. The only real difference between the Mac and PC versions lies outside of the programs or platforms themselves: Photoshop is not just software, but ground zero for an

*Photoshop is not just
software, but ground zero
for an ever-growing
mushroom cloud of
software, hardware,
standards, and services.*

ever-growing mushroom cloud of Photoshop-related software, hardware, standards, and services.

MARKET ACCEPTANCE

In the late eighties, when Photoshop first appeared (as Barneyscan XP), desktop image-manipulation offered everyone from novice users to professional photographers to high-end prepress imaging professionals new possibilities. As Photoshop gained market share, developers built their products and services around it.

In addition to its inherent advantages, the popularity and professional acceptance of the Mac version of Photoshop gives that platform—temporarily, at least—the edge on the PC version. Specialized high-end scanner plug-ins and myriad other filters are currently available only to Mac users. Depending on your needs, these features may be indispensable.

The Photoshop plug-in itself has become the Mac input standard for capturing images, and even competing packages such as Aldus PhotoStyler now accept input that is Photoshop plug-in-compliant. PC vendors, whose effort to standardize began before Adobe was even beta testing Photoshop for Windows, standardized on Twain. But PC plug-in support for both input and output is also gaining ground. Adobe has shipped 90 PC plug-in developer kits and expects at least 30 more to ship by midyear.

With Mac CPUs historically being considerably more expensive than the PC processors, many Mac users have found themselves with slower-than-optimum CPUs. Digital Signal Processing (DSP) boards remedy that situation by speeding up certain CPU-intensive processes, and many Mac-compatible products are available. DSP boards for Photoshop for Windows are not currently available, although several are expected to be released by the end of the year. But not to worry—there is a way around this for PC users. According to Bryan Lamkin, Adobe's senior product manager for Windows, loading up on RAM on the fastest CPU available will accelerate performance regardless of the platform.

It is the very success of the Mac version that will hasten the success of Photoshop for Windows, as well as that of other PC-based image-editing packages. PC users can reach out to technicians at Photoshop-savvy service bureaus, who are experts on the process of making film with the Mac version. PC users can also expect relatively quick support of many of the filters and plug-ins currently available only on the Macintosh. □

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lected area, and then recopy the image of the man over the text. This seems like far too many steps for what most professional-level packages handle with only a couple of mouse clicks. Nor were we able to make the text follow a curved Bezier path. Image-In says this feature should be included in the next release.

We had no problem separating our test image into CMYK channels. Professional can't, however, print those separations directly to a PostScript printer—unless you purchase the proper drivers. Image-In says this capability should be in the next release as well.

What Image-In-Color Professional does, it does fairly well. But it just doesn't offer enough production-level tools to merit the Professional tag. For the business user, either package would be adequate. Those who need to do serious image editing would do well to wait for the next version of Professional.

FACT FILE

Image-In-Color, Version 3.1a

Image-In-Color Professional, Version 3.1a

Image-In Inc., 406 East 79th St., Minneapolis, MN 55420; 800-345-3540, 612-888-3633; fax, 612-888-3665

List price: Image-In-Color, \$495; Image-In-Color Professional, \$795

Requires: Image-In-Color: 386-based PC or better (486 recommended), 4MB RAM (16MB recommended), 4MB hard disk space (15MB recommended, depending on image size), VGA display or better, Microsoft Windows 3.x, mouse. Image-In-Color Professional: 386-based PC (486 recommended), 4MB RAM (16MB recommended), 4MB hard disk space (15MB recommended, depending on image size), VGA display or better, Microsoft Windows 3.x 386-Enhanced mode, mouse. (Pressure-sensitive tablet and read/write optical disk drive are recommended for use with both packages.)

In short: Image-In-Color Professional is a handy package for modest image-editing tasks, but don't look for it to do anything spectacular. It has most of the retouching and selection tools you need, as does its lower-priced sibling, Image-In-Color. The implementation of these tools needs improvement, however, and you can expect to work a little harder than you might have anticipated.



ImageWare Software Inc.

ImageWizard

BY ANGELA GUNN

If you've always wanted to take a crack at image editing but it always seemed beyond your means, ImageWizard, Version 1.02, might be your entree. Priced at just \$199, this fledgling product provides no-frills image manipulation that nonetheless makes even the ten-thumbed look presentable. Professionals won't find the advanced capabilities they demand here, but ImageWizard provides neophytes and occasional users with an inexpensive means of turning out attractive images.

The package offers simple, dependable functionality: klutzproof masking, a few basic paint tools, and a crop of image-alteration options such as blurring, sharpening, texturing, and rubber-stamping. These features are well-designed, easy to use, and sufficient for cleaning up photographs and building multilayered images. The package is not geared toward sophisticated users, and it's missing a few basic tools, such as motion blur, along with high-end features like CMYK manipulation. However, its use of objects is surprisingly advanced and shows potential for further development.

CUTE UNTO DEATH

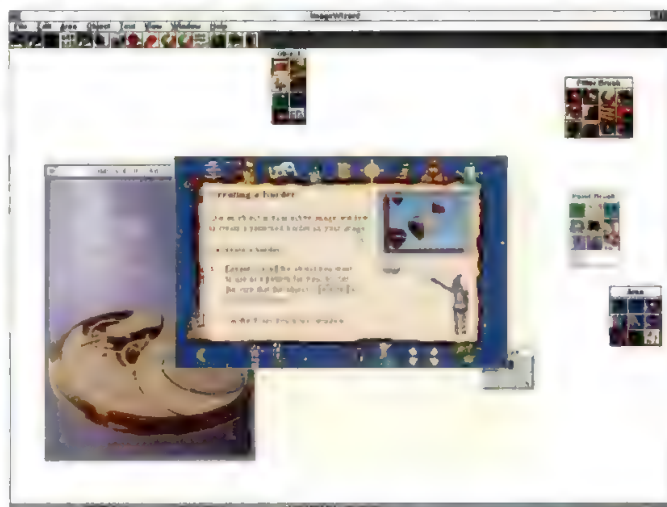
The package has a standard Microsoft Windows interface, with toolbars and boxes of icons providing access to basic features and menus supplying more complex features. The package supports icon identification through the right mouse button—useful in our testing, since ImageWizard is optimized for 640-by-480 resolution rather than for the 1,024-by-768 resolution we were working in, making the icons tough to decipher.

The icons handle the heart of the program's functionality: image masking, color selection, painting, and alterations. However, the sinew of the package is buried in menus. One common action, affix-and-delete an object, is buried four levels deep, but overall the menus are well designed and simple. Overall, the package integrates well with the average desktop system, using the Windows Print Manager and relying on Twain for most input-device support.

Learning how to use the package is much easier thanks to ImageWizard's cute-unto-death multimedia help, which guides you through the menu selections for most commands. It takes up 50 percent of the 11MB required by the package and it's not as comprehensive as the regular help screens, but the step-by-step clips of commands offer some practical advice for users venturing into the unknown. It's especially handy because ImageWizard does not use standard image-editing nomenclature: What most packages call a selection, ImageWizard simply refers to as an object.

LIBERAL OBJECTS

In this package, everything you create is considered an object. This makes ImageWizard surprisingly flexible in some cases and surprisingly inflexible in others. To create an object, you draw an outline around it, much as you would to create a mask in any image-editing package. Next, you select the area you've out-



ImageWizard features useful—if cute—multimedia help. Clicking on the silver ball activates an animated clip that shows how to use the tool in question, a handy feature for novice users.

Image-Editing Software

lined and it becomes an object you can save for future use. To make this object usable, you must affix it to the background. There's no such thing as a floating selection here.

During our testing, the object metaphor made editing and even reconstructing composite images easy, when the need arose. The metaphor makes working with text harder than necessary, though. Once you enter text in a text box, it becomes an object. Once you've affixed it as an object, you can't edit it. If you need to change your text, you'll have to delete the text object and start over.

Retouching damaged or muddy photographs, such as the black-and-white photo in our tests, is a simple process, thanks to a good selection of masking tools. These tools are pixel-precise and

very forgiving, even allowing you to go in and clean up shaky outlines before you turn them into objects. ImageWizard offers a few distort and special effects tools, but overall it's best at helping you make your photos look more like themselves. Nonetheless, we were able to construct

a reasonable facsimile of the composite "Time Is Money" image from our test script, an image that was designed with one of the professional-level packages.

And this package is no slouch when it comes to

speed. Its average time in performing an arbitrary rotate on our 64MB test-bed was a blazing 13.92 seconds—by far the fastest of all the products we tested, although it couldn't complete the test on the 16MB test-bed at all. Another area in which ImageWizard excels is image-management capabilities. The program

SUITABILITY TO TASK				
ImageWizard				
	POOR	FAIR	GOOD	EXCELLENT
Photo retouching	☒	☒	☒	☐
Creative editing	☒	☒	☐	☐
Professional imaging	N/A			
Output	☒	☒	☐	☐
Image management	☒	☒	☒	☐

FACT FILE

ImageWizard, Version 1.02

ImageWare Software Inc., 4330 La Jolla Village Dr., #270, San Diego, CA 92122;
800-842-4199, 619-457-8600;
fax, 619-457-8290

List price: \$199

Requires: 386-based PC or better, 4MB RAM, 5.5MB hard disk space (11MB recommended), VGA display or better, Microsoft Windows 3.1, mouse. (A math coprocessor is recommended.)

In short: ImageWizard, Version 1.02, delivers sturdy functionality in an inexpensive package. Its multimedia tutorial is both handy and entertaining for beginners, and business users will be surprised at the speed of this package. If you want to do basic editing and retouching but have neither the time, money, nor patience for the professional-level packages, ImageWizard is a must-buy.



offers thumbnails for all images and objects, which are clear and easy to control. You can attach notes to these images and

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Image-Editing Software

objects and then search on them to find just the image you're looking for.

CONTENDER

While ImageWizard offers some professional-level capabilities, it lacks the sophisticated color controls of those higher-priced competitors. It doesn't let you create customized palettes or generate any palette except the standard Windows palette. This made it impossible for us to create an optimized palette for a series of images to be imported into one Freelance Graphics for Windows slide. There's no support for printer calibration either, and the manual offers nothing more than a hard-copy version of the tutorial.

Neither intended nor ready for the professional market, ImageWizard should be embraced warmly by users needing ease of use rather than firepower. Its ability to work with high-resolution images and sophisticated image-management capabilities coupled with its low price may make young ImageWizard the package to beat for business and beginning image editors.

WordStar Atlanta Technology Center

PhotoFinish

BY JOHN MOORE

A cowinner of our Editors' Choice award last year, PhotoFinish from WordStar Atlanta Technology Center is an effective tool for business users who need to perform quick and simple photo retouching on small images without spending a lot of time learning esoteric concepts about working in color. The \$199 PhotoFinish, Version 2.0, is clearly not designed to handle the sophisticated tasks that professional-level products are intended for. And even if you plan to perform only the simple tasks PhotoFinish is designed for on large files, you would still be wise to look elsewhere.

PhotoFinish features an extensive and informative interface. It presents the user with a three-column (grouped) toolbox that can be ungrouped in order to display the full six columns of tools provided. Included in this toolbox are a color palette

and a Width and Shape workbook, with which you can change the size and shape of tools without having to call up a dialog box. A status bar on the bottom left of the screen indicates the pointer's position on the image and on what tool your pointer is positioned. This is particularly helpful when you are working in the pro-

SUITABILITY TO TASK				
PhotoFinish				
Photo retouching	●	●	●	○
Creative editing	●	●	●	○
Professional imaging	N/A			
Output	●	●	○	○
Image management	●	●	○	○

gram's Zoom mode: The status bar indicates the current aspect ratio and what the ratio will be if you click the left or right mouse buttons. Although you are given the status of images as they're loading, no such information is given for effects such as rotate, leaving you guessing

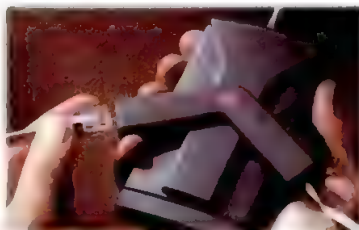
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If you and the people you work with are spending a lot of time rebuilding spreadsheets and reworking data, you should know the good news. It's called Lotus® Improv®, and it is unlike any spreadsheet you've ever seen.

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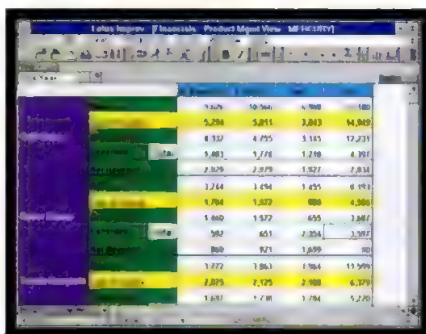
With its Dynamic Views, Improv lets you rotate, hide, show, collapse and expand worksheets in ways no traditional spreadsheet can. Rather than spending hours reconstructing worksheets to gain new perspectives, the new view is created on the spot.

A Regional Sales Manager with a major sporting goods manufacturer uses Improv to track sales activity. Dynamic Views lets her blend sales analysis with market trend data twelve months out and beyond. Improv's flexibility gives her the edge she needs for street-smart decision making.

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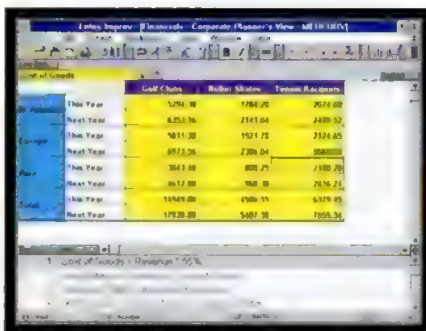
Cost of Goods." Besides being more natural than (A10 - B10), this has several big advantages. First, it's easy for anyone you work with to follow the spreadsheet's logic, even if they're looking at it for the first time.



	1992	1993	1994	1995	1996
Product A	1,526	10,764	4,768	1,881	
Product B	5,274	5,011	3,013	14,842	
Product C	8,132	4,755	5,145	12,211	
Product D	5,881	1,718	1,218	4,391	
Product E	2,526	2,075	1,521	7,812	
Product F	1,214	1,454	1,455	8,191	
Product G	1,784	1,022	886	4,384	
Product H	1,640	1,572	655	3,887	
Product I	567	651	2,354	3,927	
Product J	820	921	1,039	82	
Product K	1,777	1,861	1,784	11,599	
Product L	2,875	2,725	2,188	4,374	
Product M	1,631	1,718	1,784	5,271	

Ever see everyone get what they need from one spreadsheet? Here's the corporate financial data arranged by product.

And the formulas are general, so they can be applied to many cells at once. No matter how much you shift or expand your data, the formulas remain unchanged — there's none of

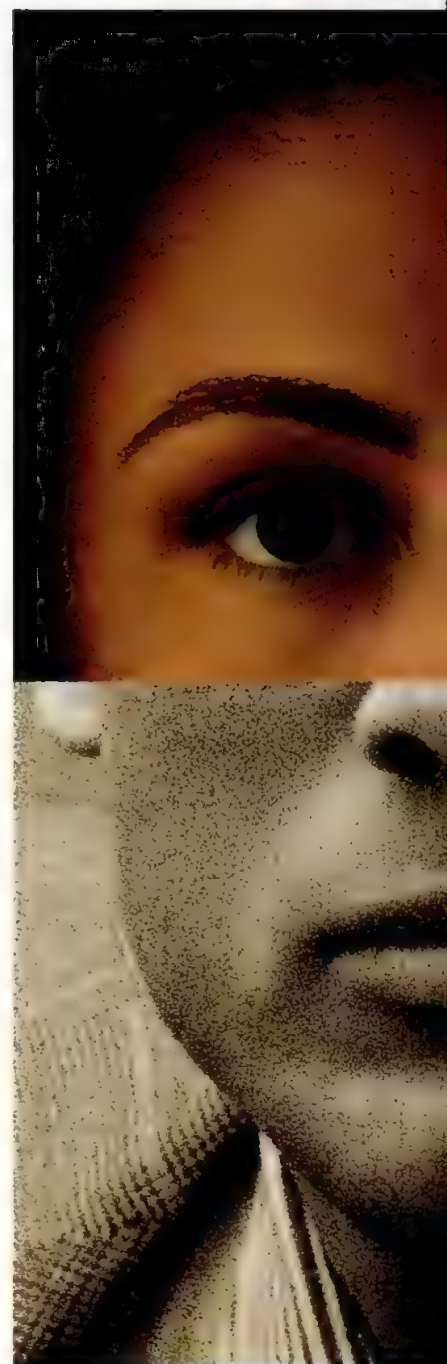


	1992	1993	1994	1995	1996
Region A	1,274.18	1,784.02	2,011.02		
Region B	8,251.76	2,141.04	2,489.52		
Region C	10,111.30	1,921.72	2,121.45		
Region D	8,723.26	2,286.04	8,888.88		
Region E	364.14	888.25	1,188.20		
Region F	45,121.88	788.18	75,151.21		
Region G	1,848.88	4,616.11	6,329.45		
Region H	1,728.88	5,881.38	7,105.34		

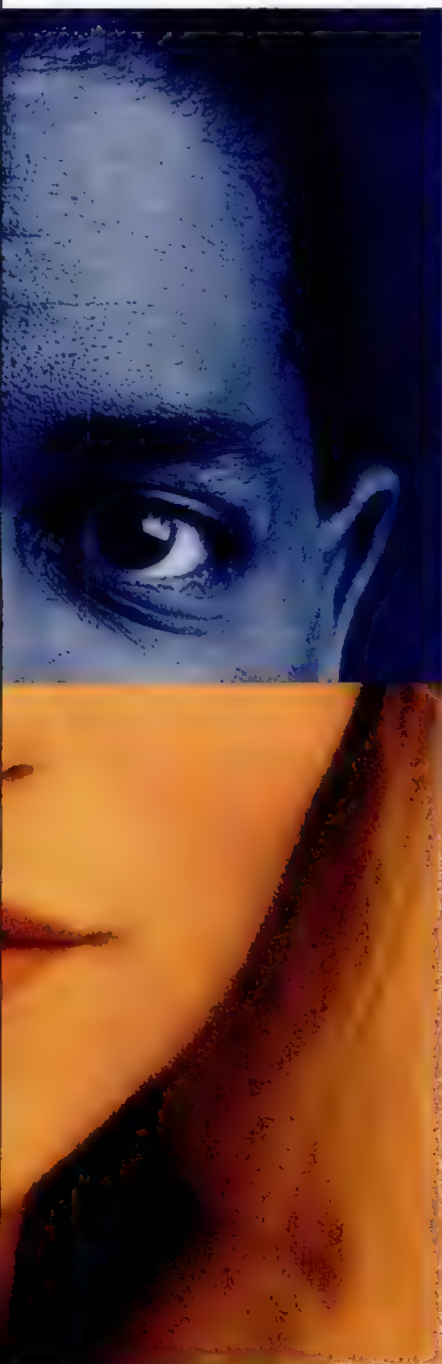
Just drag and drop for a new view, by region. Dynamic Views makes the change instantly.

the cutting and pasting of traditional spreadsheets and none of the potential for error.

A Market Trends Analyst relies on Improv to lay out trends in demographics and sport



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participation and give his people more confidence in their numbers. With Improv there are no cryptic formulas. Everything is spelled out in a way that makes sense. And there's no longer the fear of forgetting to update that one cell.

	1989	1990	1991	1992
Golf Clubs	5,276	10,500	4,100	27,100
Halter Skirts	3,244	3,454	1,455	8,793
Ladies	1,777	3,861	3,704	11,342
Total	10,297	17,815	9,259	47,235

Drag and drop again for yet another view. You can save different views for future reference.

INTRODUCING IMPROV RELEASE 2.1— DESIGNED TO WORK WITH WORKGROUPS.

	This Year	Next Year	Totals
Golf Clubs	5,276	10,500	15,776
Halter Skirts	3,244	3,454	6,698
Ladies	1,777	3,861	5,638
Total	10,297	17,815	28,112

Another drag of the mouse to view the data by year. And because the formulas are right there, in plain English, it's easy to follow.

The new network ready edition of Improv with Q+E Extend* gives you unlimited flexibility to query and access database information. The Application Field Exchange feature

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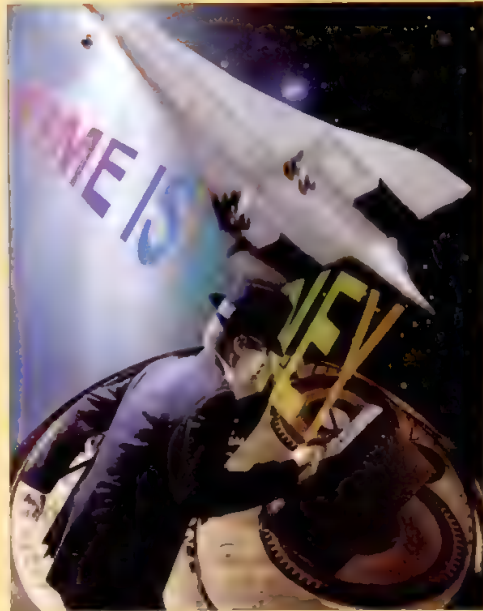
How We Tested

To test these packages, we designed a series of tasks that reflect the gamut of uses for image editing: from typical business-level tasks to professional-level production work.

To evaluate the packages' ability to handle business-level tasks, we called for reviewers to retouch a damaged gray-scale photo scanned in by a desktop scanner, to remove a moiré pattern from a second-generation halftone using special-effects filters such as Gaussian Blur, and to resample a series of 24-bit color scanned images down to eight-bit color, then to remap the images using an optimized 256-color palette. The second-generation halftone was scanned in at 1,250 dpi using a desktop scanner; the corrected image was printed on an HP LaserJet III using dot-gain values. The multiple color resampled and remapped images were used to create a single slide in a 256-color presentation.

To evaluate professional-level color production we came up with the conceptual illustration "Time is Money," an image suitable for use on a billboard or in a print advertisement. All of the pieces of this image, with the exception of the sky, started out as CMYK scans at a 266-dpi resolution. If a package could not read the CMYK files, we converted them to RGB. In some cases, we also reduced the image resolution to 75 dpi (screen resolution). Following is a step-by-step look at creating that image.—Jeff Mace

Test Image



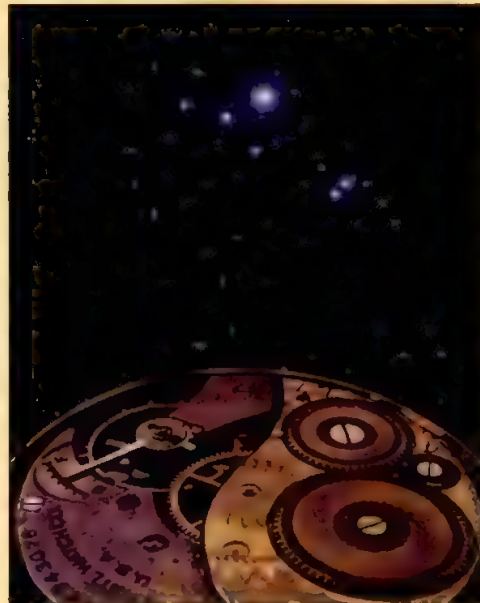
This is our completed "Time Is Money" test image, a composite image reviewers created by combining several smaller scanned in photographs. The prototype for this image was created by Maria Milne using Adobe Photoshop.

Step One



Reviewers were asked to brighten and lighten the sky in this image to make it more closely resemble a daytime sky and to increase the density of the midtones to enhance the detail. They were then asked to apply a perspective effect to the rear plane of the masked watch image to enhance its depth.

Step Two



Next, reviewers were asked to create a second watch image and darken it without losing the highlights or shadows. They were asked to use a curve set to adjust the quartertone, halftone, and three-quartertone values of the image where possible.

Step Three



The next step called for reviewers to use **Bezier** selection tools to create a perfectly smooth selection of the man, skew it to emphasize movement, and then paste it into the already assembled image.

Step Four



Finally, reviewers had to retouch the plane to correct the angle of the light source. They created a mask of the plane while retouching, lightened the original shadows on the plane, then created new ones on the opposite side.

Before and After

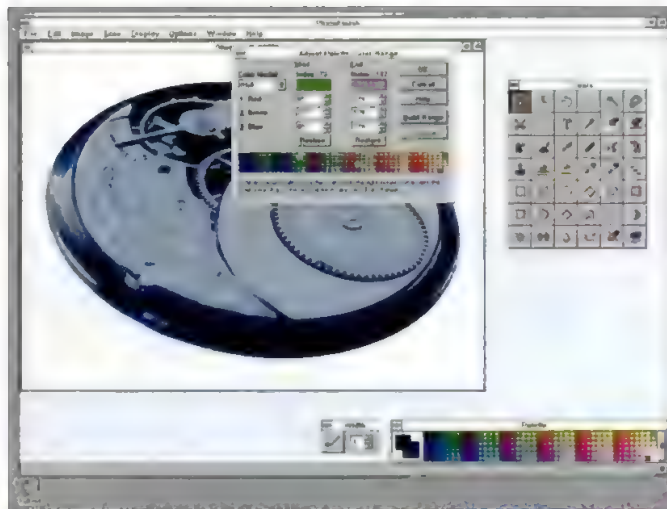


This test image contained a coffee stain as well as several nicks and scratches and a generally muddy appearance. The original black-and-white image was scanned in 24-bit RGB color format in order to maintain the color of the coffee stain.



We asked reviewers to use the available tools in their respective packages to retouch the scratches and remove the coffee stain on the damaged scan, then to adjust the contrast and brightness to bring out the details of the image.

Image-Editing Software



PhotoFinish allows you to edit a range of colors either in RGB or HLS for flexible palette optimization.

as to how long processing will take.

PhotoFinish features an excellent range of functions in its Image menu, from the handy Remove Spots command in the Filter submenu to wacky special effects like Fisheye Lens or Black Hole, which creates a squeezed effect on your image. One of this package's more unique and valuable features is its Local Undo tool, which cancels changes made since the last time you chose a command or tool. This was particularly useful in our tests when we used the clone tool to

retouch the damaged photo. PhotoFinish, unfortunately, doesn't have a Redo command.

SMALLER IS BETTER

PhotoFinish provides simple monitor color calibration via color swatches you must visually match. It offers only minimal gamma adjustment, however. PhotoFinish also supports scanning with Twain.

WordStar says there is no optimal

configuration for PhotoFinish—it all depends on the size of the image you're working with. That being the case, smaller images work much better, preferably those of no more than 1 or 2MB. Performance on our tests was as much as seven times slower on our 16MB test-bed than it was on our 64MB machine (the program took an average of 111.39 seconds to complete the Motion Blur test on the 16MB machine, compared with a 15.97-second average on the 64MB test-bed, the fastest time of any of the products tested).

PhotoFinish also crashed three times trying to perform a 90-degree rotation on our Car.TIF image. Disabling the program's virtual memory solved that problem for performing this test on the 64MB configuration only, although WordStar recommends using PhotoFinish's virtual memory when running Microsoft Windows in standard mode.

Repairing the damaged gray-scale photo in our tests was a snap with PhotoFinish's excellent cloning tool, but it was also painfully slow. Screen previews for adjusting contrast and brightness took much longer than expected. Some tasks, however, such as converting TIFF files to eight-bit .BMP files with a 72-dot-per-inch (dpi) resolution, proceeded very quickly.

Another satisfying function is PhotoFinish's palette-editing capability. Under the Palette Range of Colors command in the Options menu, you can adjust single

colors, the entire palette, or a range of colors in either RGB or HLS color mode. This helpful feature was especially useful in optimizing the palette to import our eight-bit images into Freelance Graphics for Windows.

For high-end color production tasks, such as assembling our CMYK test image, PhotoFinish isn't even in the running. High-resolution images slow the system down to a crawl (in fact, even a 12MB file is pushing the envelope). You aren't able to resample the image to a lower resolution without resizing it—changing the resolution does nothing to the file in terms of megabytes. Consequently, we were unable to perform the final section of our tests, which called for the manipulation of large, high-resolution images.

WordStar clearly knows its audience. PhotoFinish's documentation does an adequate job of explaining to beginners what each tool is designed for, and it includes a troubleshooting appendix detailing what to do when common error messages pop up.

Business users should have no problem using PhotoFinish, Version 2.0, for retouching or manipulating small image files. As a low-cost image-editing software package, it is a worthwhile investment, but you should know your limitations when working with this product.

Micrografx Inc.

Picture Publisher

PhotoMagic for Windows

BY MARLA MILNE

The image-editing market divides tidily into two tiers, and Micrografx has them both covered. The \$595 Picture Publisher, Version 4.0, is its professional-level tool for image assembly, while the \$149 PhotoMagic for Windows, Version 1.0, is the tool for business and casual users. If not for the incomplete implementation of Bezier tools and some limitations in working with CMYK files, Picture Publisher 4.0 would easily stand as the premiere Windows image-editing package available for professionals. As a tool for business users, PhotoMagic is without peer.

FACT FILE

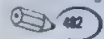
PhotoFinish, Version 2.0

WordStar Atlanta Technology Center
(formerly ZSoft Corp.), 201 Alameda del
Prado, Novato, CA 94949; 800-227-5609,
404-428-0008; fax, 404-472-1150

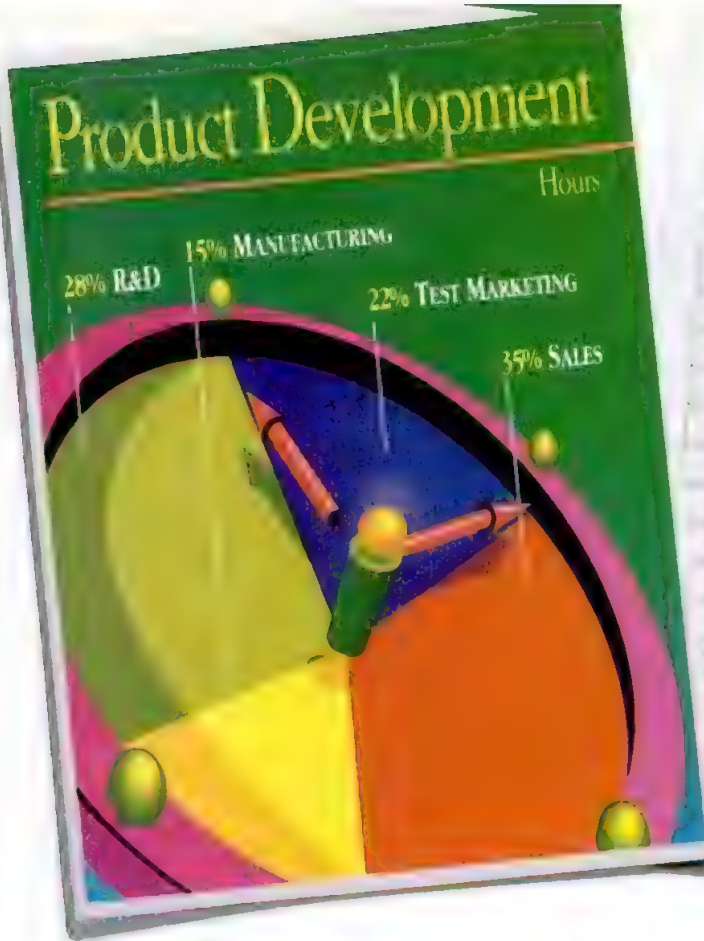
List price: \$199.

Requires: 286-based PC or better (386-based PC or better recommended), 2MB RAM (4MB recommended), 5MB hard disk space (10MB recommended), VGA display or better (SVGA display or better recommended), Microsoft Windows 3.x, mouse

In short: Thanks to its ease of use and flexible retouching tools, PhotoFinish, Version 2.0, should satisfy business users as a low-cost image-editing package. It has an extensive interface and features an excellent range of functions. Just keep in mind that you shouldn't try to push this software too far. It slowed to a crawl when editing high-resolution test images



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Image-Editing Software

Micrografx is targeting Picture Publisher at users ranging from desktop publishers to pre-press professionals. A clean and informative interface combined with good memory management, well-defined retouching tools, and support for CMYK editing provide the foundation for this market positioning. The package provides support for all pixel depths—including black and white for line art,

eight-bit gray-scale for monochrome pictures, 24-bit RGB for desktop scanners, and 32-bit CMYK—as well as a wide range of file formats.

Picture Publisher's interface maintains its overall look and simplicity while offering the type of tools professional users require. Variable options for all tools are available through lists, which pull down to reveal the range of selec-



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SUITABILITY TO TASK

Picture Publisher

	POOR	FAIR	GOOD	EXCELLENT
Photo retouching	●	●	●	○
Creative editing	●	●	●	●
Professional imaging	●	●	●	●
Output	●	●	●	●
Image management	●	●	●	●

SUITABILITY TO TASK

PhotoMagic for Windows

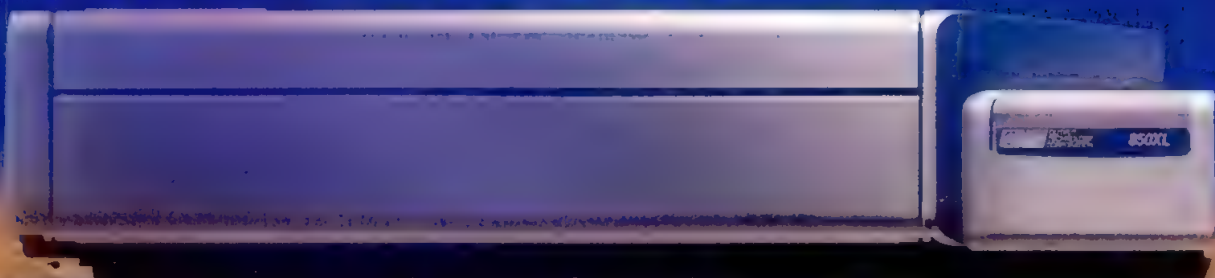
	POOR	FAIR	GOOD	EXCELLENT
Photo retouching	●	●	●	○
Creative editing	●	●	●	●
Professional imaging	N/A			
Output	●	●	●	●
Image management	●	●	●	●

tions. Other tool-specific features are toggled on and off by clicking buttons on the ribbon.

A powerful ImageBrowser with thumbnail images and user-definable albums compensates for Windows' lack of a seamless interface for file management. This browser includes Albums, a unique feature that allows you to define collections of files that may reside across networks or locally on multiple volumes; you can open the files in an album, no matter where they reside, and save them to a master list complete with Thumbnails for quick identification and recall. As a result, you spend less time searching through volumes.

Another winning interface design is found in the EffectsBrowser. Placing all the available effects within the same dialog allows you to apply different effects to the same image, inviting you to experiment freely.

In addition to these features, Micrografx has added two options to speed up the process of working with large images. The FastBits option allows you to select a piece of a large image to open and load into memory for retouching. Any changes you make to this chunk are applied to the whole image when you choose Save or Close from the file menu. The handy Low Res Image Open option



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Composer and PhotoStyler

by Pauline Ores

Now that Adobe Photoshop—considered the leading professional package on the Macintosh—is available for Windows, the competition in the image-editing market is really heating up. The latest entrants are a brand new package, Altamira Composer, and a revamped package that just seems new, Aldus PhotoStyler. Both were in beta when we were testing but should be available by the time you read this.

Altamira, a new venture funded by Autodesk and research computer scientist Dr. Alvy Ray Smith, hopes the \$795 Composer, its first product, will change the way users work with images.

It is Altamira's *Dynamic Alpha* technology that makes Composer a standout in the image-editing arena. Not only does Composer allow you to see through a transparent vase, for example, as you place it in front of another object, but the program can treat portions of an image as objects—that is, you can save them in a library and move any number of them around the screen to your heart's content. For anyone using image-editing programs to perform extensive image manipulation, cloning, and moving items in a production setting, this technology is invaluable.

Working in Composer, however, is like creating a paper collage: You can move elements without damaging the elements underneath, and then when it's time to print you can glue all the elements together by using Composer's flatten composition command. Not merge or glue, but flatten, and that's a little bit of the rub in using Composer.

Composer has a sophisticated user interface (the cursor can change into a number of shapes implying different functions) that might be expedient once you are intimately familiar with the system—but you have to get to that point. Also, Composer has perhaps the

smallest and most obscure icons of any graphics program known to mankind. Even when you know what they stand for, they are hard to discern as each may only differ by a few pixels.

Coming from the world of high-end computer graphics (and using a programming staff brought over from Autodesk) has enabled Altamira to bring something new to the market. However, the product expects users to learn its conventions, and the process of working on images in Composer is quite different than it is in other image-

Coming from the world of high-end computer graphics has enabled Altamira to bring something new to the market.

editing programs.

Altamira Composer is truly a breakthrough product, and heavy production users, who have the most to gain, will probably be willing to learn a new interface and method of working with images. Occasional users might be better off waiting for similar features to be added to their existing software.

TAKING NO CHANCES

Although the upcoming release of Aldus PhotoStyler for Windows is an upgrade, the number of features and changes make it seem almost like a new product. With this product, Aldus is ready to stake a claim on the professional image-editing market many thought would be the sole province of Adobe Photoshop while making the product easier for novices to master.

The PhotoStyler upgrade not only

offers a boatload of new features, but sports a brand new look. Rather than add features randomly, Aldus wisely chose to focus on improving the process of working on images within PhotoStyler—making it a premiere production tool for the intensive image-editing user while simultaneously making it easier for the novice to use.

In order to achieve this lofty goal, Aldus has made significant changes in a number of areas. The new version of PhotoStyler features a Quick Command Palette, with which users can arrange the tools that they need most by creating custom floating-tool palettes. Aldus has also added new task-specific tools that offer users a one-step method of accomplishing tasks that previously took several steps. PhotoStyler also supports Object Linking and Embedding (OLE) and works—big surprise here—especially well with the entire suite of Aldus products (including PageMaker, FreeHand, and Persuasion).

Along with the new features, parts of the program have been rewritten to make better use of system memory, thereby speeding the process of editing images, especially large ones. Another time-consuming task is the cycle of modification and output users go through to achieve color-balanced film. As we go to press, the upcoming version of PhotoStyler will be the only image-editing package that has a built-in color-management system (Kodak's Precision Color), which Aldus claims enables its users to get accurate color output without the typical trial-and-error method normally required.

With this revision, PhotoStyler offers the functionality professionals demand and the ease-of-use that image-editing novices require. It may not be as revolutionary as Altamira Composer, but PhotoStyler looks like a fierce competitor. Which one you choose will depend on your needs. □

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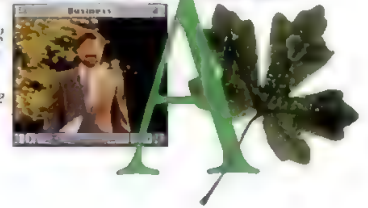
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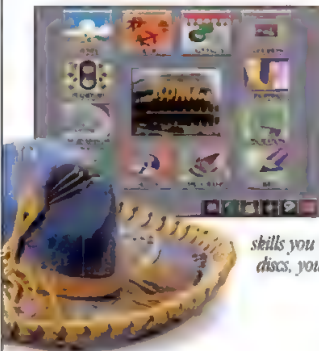
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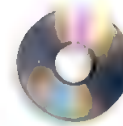
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Roger Ebert's Home Movie Companion



New Grolier Multimedia Encyclopedia



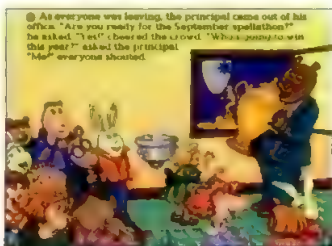
Spaceship Warlock sci-fi game



Mayo Clinic Family Health Book



Exotic Japan



Learning is fun with educational CDs like Arthur's Teacher Trouble, which let young readers control the story.



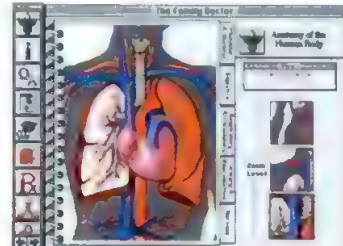
The Outdoor Athlete training CD



Rock, Rap & Roll music machine (Macworld CD Ventures)



U.S. Presidents



CDs offer unparalleled new resources. The Family Doctor, for instance, is a richly illustrated, interactive health manual.



Dialog Daily Newspapers on CD



Adobe Font Folio



Mastering Math



Scurry Poems for Rotten Kats



All About Science



Business Backgrounds clip art/sound



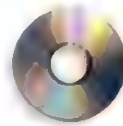
Who Built America? documentary



Computer Select buyer's guide



History of the World



The Business Week 1000



800 College Boards preparation



World Atlas



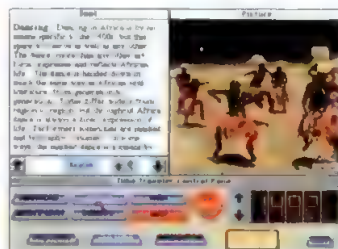
Shakespeare complete works



Macworld Interactive



The Greatest Children's Stories Ever Told



CDs allow you to skip immediately to what interests you the most. Just set the clock in the Time Traveler CD and go.



Developing Writing Skills



Peter Gabriel Explora (Brilliant Media)



Marketplace direct marketing system



Impressionism: Coates Art Review



The David Bowie CD-ROM (ION)



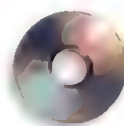
The View from Earth space study



Ocean Life



Adobe Type on Call



Battle Chess



Conception to Birth pregnancy guide



Let's Visit South America



Career Opportunities



AccuZip6 business mail manager



Sound Library 2000 (Wayzata)



Monarch Notes on CD-ROM



Dinosaurs! Multimedia Encyclopedia



Clinton Portrait of Victory

The most exciting software available today is only on CD-ROM discs. That's because CDs can hold an incredible amount of audio-visual information, making possible software that would be too impractical or too expensive with floppy disks, or even with a hard drive. Right now there are thousands of titles for Macintosh[®] and PCs running Windows. They cover virtually every conceivable

he choices.



*Guinness Multimedia
Disc of Records*



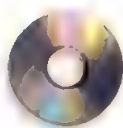
*RGB/CIA World
Factbook*



*Rodney's
Wonder Window*



The Complete Audubon



*Isaac Asimov's
The Ultimate Robot*



*Berlitz
Tom & Talk French*



*National Register of
Historic Places*



*Twelve Roads to
Gettysburg*



*Desert Storm
(Time)*



*NibongoWare
Japanese course*



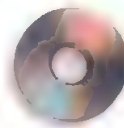
*The Best of
Mark Twain*



*Entertainment becomes far more involving with
audiovisual games. In Who Killed Sam Rupert?,
you're the detective.*



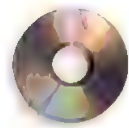
Poetry in Motion



*Countries of the World
Encyclopedia*



*Terrorist Group
Profiles*



*DNA VideoShop &
The Image Bank CD*



*Snavinsky: The Rite
of Spring (Noyager)*



*North American
Indians*



*Sports Illustrated
Almanac*



*Lunatics
3-D moonbase survival game*



*Ephemeral Films
documentaries*



*History of the Blues
(Queue)*



*Learn to Speak
Spanish*



How Computers Work



*Lila's Kitchen:
Exotic Vegetables*



*The Adventures of
Pinocchio*



*Dictionary of
the Living World*



*USA Wars:
World War II*



*The Great Buildings
Collection*



*Experience the sights and sounds of the world.
From Alice to Ocean follows one woman's
amazing trek across the Australian outback.*



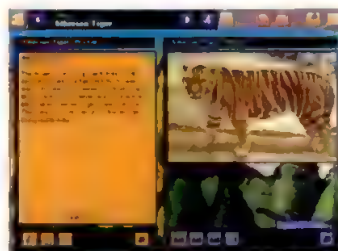
Talking Jungle Safari



*Sherlock Holmes,
Consulting Detective game*



*A Silly Noisy House
audio toy box*



*CDs combine media in entirely new ways
The Animals! lets you control film clips, photos,
text and sound with friendly screen icons.*



*The Magic Flute
(Warner New Media)*



*Funny
(joke-tellers on film)*



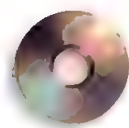
*Great Wonders
of the World*



*The Orchestra
(Warner New Media)*



Aesop's Fables



*America Alive! G1 TDisc
travel guide*



*LifeSaver2:
First Aid Course*



*Curious George
Learns the Alphabet*



InPrint Art Library



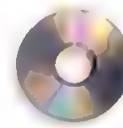
*20,000 Leagues
Under the Sea*



Digital Video Library



*Indiana Jones
adventure game*



*Uncle Alex's
Guitar Tutor*

topic and interest, from business directories to cooking lessons, from nature programs to a street-by-street atlas of the United States. Only a fraction of the available CDs are shown here. New releases come out every week, and there are hundreds of titles in development. So if you don't have a CD-ROM drive in your computer, you're not just missing the fun. You're missing the future.

All you need

For PowerBook owners.

The single-speed, multi-session Apple® PowerCD player is the ultimate in portability. The PowerCD easily connects to Apple PowerBook® computers, any other Macintosh or even a TV.

For Windows owners.

With the CD Multimedia Kit for PCs, you can get going right away. And it exceeds Multimedia PC Level 2 specifications. It includes:

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AppleDesign® Powered Speakers. For crisp, CD-quality sound.

A free CD package. Compton's Encyclopedia on CD, the Multimedia Starter CD and up to three more CDs which you can select from over 20 of the top titles for Windows listed in our special brochure.

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AppleDesign® Powered Speakers. For true CD-quality sound.

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If you have a Macintosh, or a PC running Windows software, you can take advantage of great deals on premium multimedia bundles. The AppleCD® Multimedia Kit for Macintosh and the CD Multimedia Kit for PCs are each valued at over \$1500.* They're now available for less than half that. To get your kit, or the portable PowerCD, call today.

is the drive.



**To get your AppleCD 300,
call 800-732-5151, ext. 100.**

The drive.

Recently, the AppleCD 300 disc drive was named *Macworld's* Editor's Choice for Overall Value. Why? This double-speed drive is significantly faster than many other CD-ROM drives available today, yet it's still quite affordably priced. At \$429,* the AppleCD 300 is a great deal. And to get it, all you have to do is call the phone number above.

*All prices are Manufacturer's Suggested Retail Prices as of 8/1/93. Retailer prices may vary.

If there's a computer in your future, make sure there's a future in your computer.



Integrated Apple CD-ROM.

From this point on, a computer without a CD-ROM drive won't allow you to take advantage of the best computing has to offer. So if you're thinking about a new computer, consider one of the many Macintosh® models with the AppleCD™ 300i already built in. That's the easiest way to start exploring the vast array of CD titles available for Macintosh, and the many more to come. Call 800-732-5151, ext. 100, to locate an authorized Apple reseller, and stop in for a demonstration. With a CD-ROM drive inside it, you'll find that a new Macintosh delivers the most impactful kind of power. The power to be your best. **Apple** 

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Performance Tests: Image-Editing Software

When it comes to image editing, the more RAM the better. Each package turned in exceptional scores on a test-bed configured with 64MB of RAM, in some cases quadrupling its performance on a test-bed configured with 16MB of RAM.

How We Tested

We evaluated these packages on Compaq Deskpro 386/25M EISA systems equipped with 486DX2/66 upgrade cards, 310MB 15-ms IDE hard disks, and SuperMac Thunder/24 EISA Windows graphics adapters running at 1,280-by-1,024 resolution. One set of systems was outfitted with 16MB of RAM, and another with 64MB of RAM for the professional-level production tasks. All test-beds used SuperMac's SuperMATCH 20-T XL 20-inch monitors and the Wacom SD-510C, a 6-by-9-inch tablet, with both its pressure-sensitive stylus and its puck. For scanning, we used the Microtek 45t slide scanner and ScanMaker II flatbed color desktop scanners. We set Windows Swapfile and SmartDrive configurations for each package in accordance with the respective vendor's specifications.

We used Scitex drum scans on 5.25-inch Syquest cartridges and the PLI (Peripheral Land Inc.) Infinity 88/RW44 SCSI drives, along with PCI's Mac-to-DOS software for file conversions. Each reviewer was required to calibrate their system's video based on match prints ordered with the CMYK scans. To do this, we used the SuperMac hardware-calibration system in conjunction with calibration features offered by each program.

Neither ImageWizard nor PhotoFinish could complete the Arbitrary Angle Rotate test on our 16MB test-bed because of memory constraints, although both programs did complete it on the 64MB test-bed.

The **Arbitrary Angle Rotate** test measures the time it takes to rotate a selected region 153 degrees clockwise.

The **Motion Blur** test measures the speed at which a motion blur of 40 pixels can be applied to a selection.

allows you to open and make global changes to a low-resolution copy of your large, high-resolution file. You can choose the specific resolution for this image; when you're done working with the image, you record a macro of your changes, and then play this macro back on the full-resolution image.

LAYERING OPTIONS

Picture Publisher treats selected elements of bitmapped images as separate, floating selections. You can visually combine images, and you can mask, blend, rotate, and scale multiple pasted elements until you're satisfied with the positions, sizes, and blends. Then you can commit

your edits to the base image. A list of thumbnail images is available in a floating window to identify the separate layers. As layers of an image are created—either through copy/paste or imported from named clipboards—the titled image grows accordingly.

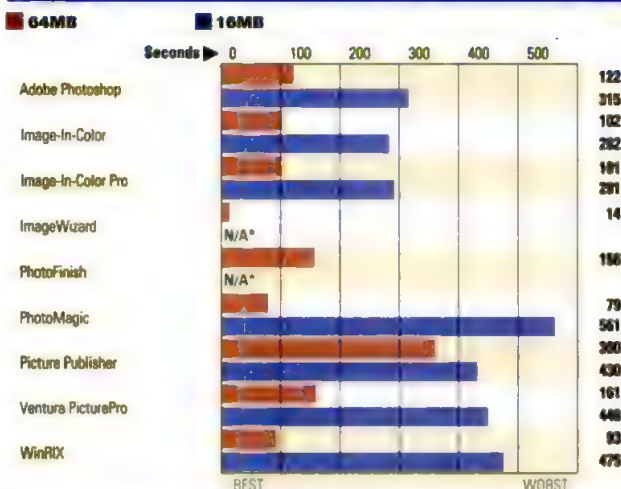
Users familiar with the behavior of object layers will find their expectations fulfilled; all the usual options are available here, including the ability to move a layer forward or backward, to group layers (which we found useful for performing a matched move such as a perspective distortion on multiple layers), and to edit the color of the selected object without affecting the rest of the image. Some

common commands are missing, however, including align and snap-to-grid.

Picture Publisher features some enhanced masking capabilities that should give users more flexibility when compositing images. The program now supports alpha channels with intuitive editing functions, including one-button user access; Paintable Masks, which allows you to use the paint brush to apply a mask to an image; and the Bezier Mask option, with which you can reshape a mask in Bezier-editing mode.

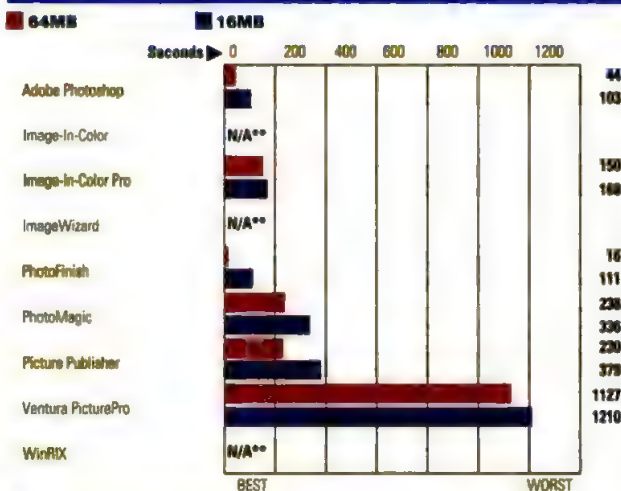
Those familiar with masking from other applications will need to reorient their understanding of the relationship between the mask layer and a pasted

ARBITRARY ANGLE ROTATE



N/A*—Not applicable: Both ImageWizard and PhotoFinish failed to complete this test on our 16MB test-bed.

MOTION BLUR



N/A**—Not applicable: These packages do not offer a motion blur filter.

GRAPHICS
Image-Editing Software

► **S U M M A R Y O F F E A T U R E S**

Products listed in alphabetical order

■ = YES □ = NO

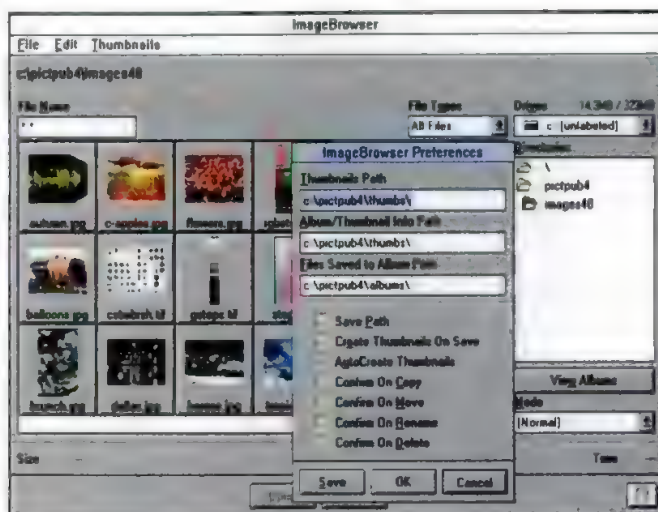
PC MAGAZINE
EDITORS' CHOICE

PC MAGAZINE
EDITORS' CHOICE

	Adobe Photoshop for Windows	Image-In-Color	Image-In-Color Professional	ImageWizard	PhotoFinish	PhotoMagic for Windows
List price	\$895	\$495	\$795	\$199	\$199	\$149
General Features						
Minimum memory required	4MB	4MB	4MB	4MB	2MB	4MB
Minimum disk space needed	40MB	4MB	4MB	5.5MB	5MB	5.3MB
Fixed/variable zoom	■ □	■ ■	■ ■	■ □	■ □	■ ■
Revert to last-saved version	■	■	■	□	■	■
Macro recorder	□	□	□	□	□	□
OLE support	None	OLE 2.0 (server)	OLE 2.0 (server)	OLE 1.0 (server)	OLE 1.0 (server)	OLE 1.0 (server)
Named clipboards	□	□	□	□	■	■
File interchange:						
EPS:						
Interprets and renders EPS files	■	□	□	□	□	□
Writes with TIFF preview	■	■	■	□	■	■
Writes without TIFF preview	■	■	■	■	■	□
.IFF (Amiga) (reads/writes)	■ ■	□ □	□ □	□ □	□ □	□ □
JPEG (reads/writes)	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■
Kodak Photo CD (read only)	■	■	■	■	■	■
Macintosh formats	MacPaint, Pixar, Pixelpaint	MacPaint, Mac TIFF	MacPaint, Mac TIFF	None	Mac TIFF	Mac TIFF
.PCX (reads/writes)	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■
Scitex CT (reads/writes)	■ ■	□ □	□ □	□ □	□ □	□ □
.TGA (reads/writes)	■ ■	■ ■	■ ■	■ □	■ ■	■ ■
32-bit (reads/writes)	■ ■	■ □	■ □	■ ■	■ □	■ □
TIFF compressed (reads/writes)	■ ■	■ ■	■ ■	□ □	■ ■	■ ■
Painting Tools						
Airbrush	■	■	■	■	■	■
User can specify pressure/thickness	■ ■	■ ■	■ ■	□ □	■ ■	□ ■
User can specify transparency	■	□	■	□	■	■
Brush	■	■	■	□	■	■
Edit brush shape/Save brush	■ ■	□ □	□ □	N/A	■ □	■ □
User can specify thickness/transparency	■ ■	■ □	■ ■	N/A	■ ■	■ ■
User-defined textures	■	□	□	N/A	□	□
Color-sensitive paint modes	■	□	□	■	■	■
Circles and ellipses	■	■	■	■	■	■
Bezier/freehand curves	■ ■	□ ■	□ ■	□ ■	■ ■	□ ■
Spline curves	■	□	□	□	□	□
Linear and radial gradient fills	■	■	■	■	■	■
Choose angle (linear fills)	■	■	■	■	□	■
Choose angle (gradient fills)	■	■	■	□	□	■
User can specify more than two colors	□	■	■	■	■	□
User can specify line thickness/transparency	■ ■	■ ■	■ ■	■ □	■ □	■ ■
Smudge	■	■	■	■	■	■
Image Processing						
Auto density	■	■	■	■	■	■
Color and gray-scale correction	■	■	■	■	■	■
Edits in RGB/CMYK mode	■ ■	■ ■	■ ■	■ □	■ □	■ □
Color balance	■	■	■	□	■	■
Gray balance	■	□	□	■	■	□
Select highlight, midtone, and shadow	■	■	■	□	■	■
Dither	■	□	□	■	■	■
Equalize	■	■	■	□	■	■

• N/A—Not applicable: The product does not have this feature

object when working with object layers. Selecting Mask Image or Mask Object determines which mask will be active. This was a problem when we tried to fill the text of our test image with a gradient fill. Because the other layers had been combined with the base image, a mask was loaded to protect the Guy.TIF image. When we performed the gradient fill on the text, the mask prohibited



Picture Publisher's powerful imageBrowser, with thumbnail images and user-definable albums, compensates for Windows' lack of a seamless interface for file management.

the fill from entering areas adjacent to the mask, since all masks reside on a single alpha channel.

With Picture Publisher, a mask can be merged with single or multiple layers. This proved useful in our tests when we blended the light watch with the dark watch using a gradient mask in the base image. While the two object layers were blended, we color-edited the darker version, enabling us to get an exact visualization of the color balance.

Bezier tools, as implemented in Picture Publisher, are line Bezier's as opposed to spline or Bezier curves. (Curves can be added to the line segments one step at a time through a point editor, or by using the Freehand mask tool to turn a line into a Bezier curve.) The results for mask creation are the same in terms of quality, but the process is less efficient. This also means that there is no direct support for importing Bezier drawings from other applications. Full implementation is slated for the next release.

A likely cause for concern for pre-press professionals is Picture Publisher's limited CMYK support. The package lacks the ability to view the primary layers of a color image without splitting the file, and it doesn't provide support for the Scitex CT image format, which is widely used in professional color trade shops. Also, the color calibration system is

designed for RGB input and CMYK output, leaving no efficient way to set the screen display to represent the CMYK environment best.

Picture Publisher's color-correction falls short when measured against the high standard of design and development apparent elsewhere in the application. For example, the package doesn't allow you to read values from the screen when a color-correction dialog is opened. During the assembly of our CMYK test image "Time Is Money," we found this glitch to be a frequent annoyance.

One of Picture Publisher's more impressive features is its 3-D color approach, by which you can edit the secondary components of image pixels as well as their primary components. When we were adjusting the density of the dark watch for the test image assembly, we decided to color-edit the highlights to reflect the blue of the background sky by using Color Map Curves and selecting blue to edit. By increasing the blue in the highlight range of the color curve, those pixels with a balance of cyan and magenta were adjusted proportionately.

Business and casual users will want to investigate PhotoMagic 1.0, which includes about 80 percent of the capability found in its professional-level sibling at almost a quarter of the price. Like Picture Publisher, one of PhotoMagic's principal



1

4

7

HOPE

5

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2

3

"WASHINGTON" WILL NEVER BE THE SAME. IT ALL STARTS WITH FIVE SCANNED IMAGES AND THE MAGIC OF ADOBE PHOTOSHOP. ① SKY IS SELECTED USING CROPPING TOOL AND RESIZED USING IMAGE SIZE OPTION. ② FIELD IS CAREFULLY CUT OUT AND ADDED USING QUICK MASK FEATURE. ③ INDIVIDUAL FLOWERS ARE COLORED USING PAINT TOOL. ④ THE STARS ARE CREATED USING ADOBE ILLUSTRATOR™ AND IMPORTED INTO ADOBE PHOTOSHOP WHERE COMPOSITE CONTROLS ARE USED TO BLEND THEM INTO AZURE SKY. ⑤ TO ERASE A PESKY FLAG IN FRONT OF OUR "CAPITOL," ANOTHER SECTION OF DOME IS CLONED IN ITS PLACE. ⑥ SMALLER SECTION OF A MUCH LARGER HOUSE IS SELECTED AND WINDOWS ARE CUT OUT SO FLOWERS SHOW THROUGH. ⑦ TYPE TOOL GIVES US "HOPE," ANTI-ALIAS TEXT TOOL PERMITS TYPE TO SIT ON IMAGE, AND LETTERS ARE "WEATHERED" WITH COMPOSITE CONTROLS. ⑧ DODGE AND BURN TOOL GRACEFULLY SALTS AND PEPPERS SAX DUDE'S HAIR. ⑨ CLONED FLOWER IN LAPEL IS A NICE TOUCH.

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CIRCLE 368 ON READER SERVICE CARD

GRAPHICS
Image-Editing Software

► **S U M M A R Y O F F E A T U R E S**

Products listed in alphabetical order

■ = YES □ = NO



**Adobe Photoshop
for Windows**

Image-In-Color

**Image-In-Color
Professional**

ImageWizard

PhotoFinish



**PhotoMagic
for Windows**

Image Processing (continued)

Histogram	■	■	■	□	■	□
Hue/Saturation	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■
Negative/Posterize	■ ■	■ ■	■ ■	□ ■	■ ■	■ ■
Palette handling:						
Color models supported:						
CMYK	■	□	■	□	■	□
HLS	■	□	□	■	■	■
HSV	■	■	■	□	□	□
RGB	■	□	■	■	■	■
Color picker/Color editing	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■
User-definable palettes	■	■	■	■	■	■
Resample/Resize	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■
Skew/Perspective	■ ■	■ ■	■ ■	■ ■	■ □	■ □
Tone correction	■	□	□	□	■	■

Image-Editing Tools

Alpha channels:						
Multiple channels	■	□	□	□	□	□
User can combine channels	■	□	■	□	□	□
User can edit individual channels	■	□	■	□	□	□
Bitmap selection tools:						
Circle/Ellipse	■ ■	■ ■	■ ■	□ □	■ ■	■ ■
Edit nodes	■	■	■	□	□	□
Expand selection by color similarity	■	■	■	■	□	□
Magic wand (by color)	■	■	■	■	■	■
Move, resize, and edit selection	■	■	■	■	■	■
Polygon/Rectangle	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■
Save selection	■	■	■	■	■	□
Select all/Invert selection	■ ■	■ ■	■ ■	■ ■	■ □	■ ■
Clone	■	■	■	■	■	■
Filters:						
Add noise	■	■	■	□	■	■
Averaging	■	■	■	■	■	■
Despeckle	■	■	■	□	■	□
Detect/enhance edges	■ ■	■ ■	■ ■	□ □	■ ■	■ ■
Emboss	■	□	■	□	■	■
Gaussian blur	■	□	□	□	□	□
Motion blur	■	□	■	□	■	■
Smooth	■	□	□	□	■	■
User-definable filters	■	■	■	□	□	□
Image combination:						
Add/Subtract	■ ■	□ □	■ ■	■ ■	□ □	■ ■
Composite (combine with mask)	■	□	■	■	□	□
Anti-alias	■	■	■	□	■	■
User can specify opacity	■	□	□	■	■	■
Masks:						
Save masks	■	■	■	■	■	N/A
Save masks as alpha channels	■	□	□	□	□	N/A
Create masks using Bezier/freehand curves	■	■	■	□	□	N/A
Create masks using spline curves	■	□	□	□	□	N/A
Paste into/outside selection	■ ■	■ ■	■ ■	■ □	□ □	■ ■
Split into or combine color channels	■	□	■	□	□	□
Splittable models	All	N/A	CMYK, HSV, RGB	N/A	N/A	N/A
View individual channels	■	N/A	■	N/A	N/A	N/A

N/A—Not applicable. The product does not have this feature.

Image-Editing Software

CONTINUES

Picture Publisher	Ventura PicturePro	WinRIX
☒	☒	☒
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☒	☒	☐
CMYK, HSL, RGB	RGB	N/A
☒	☐	N/A

strengths is an informative, easy-to-master interface.

PhotoMagic provides exceptional creative control and functionality for its targeted users. Its thumbnails and Image-Browser are the best image-management options you're likely to find in any business-level image-editing package. Like its higher-priced sibling, PhotoMagic provides thumbnail previews of filter adjustments in the EffectsBrowser dialog box and useful color tools, such as a color probe and a color shield.

PhotoMagic features a full array of selection tools as powerful as those found in Picture Publisher. Business users will appreciate the creative control afforded by the ability to set the degree of transparency of a selection or to transform it with ease, and to create selections based upon a user-specified range. About the only thing lacking is the ability to combine masks.

In our tests, we found retouching and enhancing photos simple, thanks to PhotoMagic's powerful selection tools and a wider selection of draw and paint tools than can be found in many professional-level packages. Some of these offerings, such as the natural-media brush styles and colorizer tool, make it easy to go from business user to creative artist with a few mouse clicks.

What keeps PhotoMagic out of the professional realm are its lack of support for importing and editing CMYK images, eight-bit masking, Bezier line-editing controls, expanded control over automatic mask selection, image protection through multiple color ranges, and the ability to manage larger image files. Business users, however, will not miss these abilities.

With its strong image-management capabilities and tools for creative editing, PhotoMagic is the ideal choice for business-level image editors and those looking for a quick path to creativity. For professionals, Picture Publisher provides all the power needed, if not always in the most efficient manner. But by laying the groundwork for object-oriented development, Micrografx has taken a product, mature in traditional image-editing vocabulary, and pushed it to the limit. Time and another release, however, are needed to smooth out the edges.

FACT FILE

PhotoMagic for Windows, Version 1.0

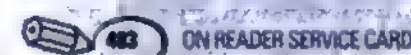
Picture Publisher, Version 4.0

Micrografx Inc., 1303 East Arapaho Rd., Richardson, TX 75081; 800-676-3110, 214-234-1769, ext. 5050 (in Canada); fax, 800-994-6475

List price: PhotoMagic, \$149; Picture Publisher, \$595.

Requires: PhotoMagic: 386-based PC, 4MB RAM, 5.3MB hard disk space (10.5MB recommended), VGA or better display, DOS 3.1 or later, Microsoft Windows 3.1, mouse; Picture Publisher: 386-based PC (486 recommended), 4MB RAM (8MB recommended), 5MB hard disk space (15MB recommended), VGA or better display (16-bit or better video card recommended), DOS 5.0, Microsoft Windows 3.1, mouse, (A CD-ROM drive is recommended).

In short: A clean and informative interface, well-defined retouching tools, and support for CMYK editing make Picture Publisher 4.0 a strong tool for professional image editing. Only a few glitches prevent it from being the premiere image-editing product in the Windows environment. Business users should stick with PhotoMagic, which not only includes the same clear interface and all the functionality you're likely to need, but also boasts an array of paint tools that can challenge those found in most professional-level products.



Ventura Software Inc.

Ventura PicturePro

BY DON LABRIOLA

Ventura PicturePro, Version 1.1, is like the chess master who loses a championship match in the final moves. This \$795 package from Ventura Software has an impressive set of features that should have made it a contender for top honors, but its strengths are undercut by a few critical flaws that render it nearly unusable for production work.

PicturePro is aimed at service bureaus and professionals who process large, high-resolution images. It's designed to be a general-purpose package, with a wide selection of photo-retouching and paint tools, object-drawing features, special effects, and output controls.

At first glance, PicturePro's user inter-



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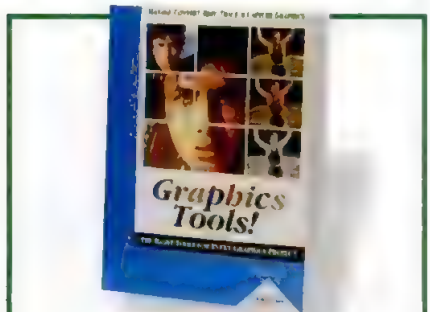
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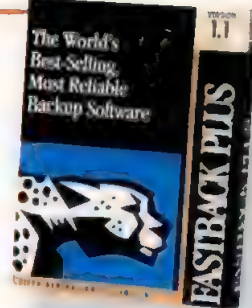
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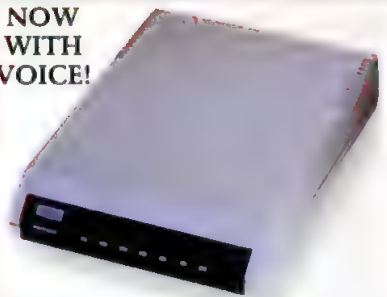
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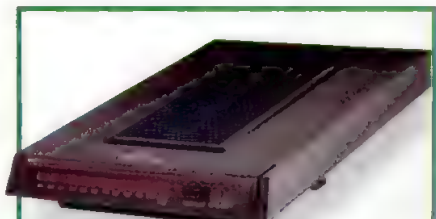
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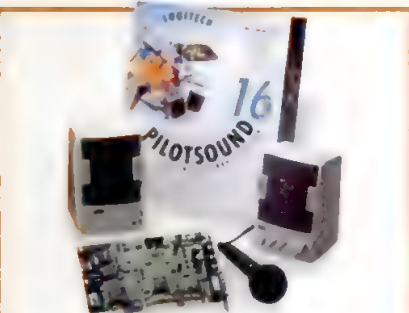
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7809 BJ-200 BubbleJet Printer 315. 12547 BJ-230 419.	
CoStar ... 1 year	
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Epson ... 2 years	
5555 AP-3250 (80 col., 200 cps, 24 pin).....	199.
11800 LC570+ (80 col., 269 cps).....	269.
10784 Action Laser 1500 (1 MB).....	789.
11495 Stylus 800.. 369. 10784 ActionLaser 1500..	789.
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12212 LaserJet 4L (with toner).....	729.
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6442 LaserJet 4 (with toner).....	1499.
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3295 Mouseman (combo).... 69. 9766 (cordless)....	89.
7975 ScanMan256 179. 2468 w/OminiPage Direct	225.
Microsoft ... lifetime	
7597 Microsoft Serial Mouse 69. 1896 Ballpoint Mouse	115.
2698 Mouse with Windows 3.1 (serial).....	145.
MicroSpeed ... 1 year	
6007 PC-TRAC Trackball 59. 11222 KB101 Keyboard 40.	
Microtek ... 1 year	
5187 ScanMaker II 879. 5175 ScanMaker IIxe 1099.	
11859 ScanMaker II with Transparency.....	1449.
Mouse Systems ... lifetime	
7878 PC Mouse III (serial).. 69. 5427 NewMouse ..	62.
Mustek ... 1 year	
8452 Gray Artist for Windows (256 GS hand scanner)	165.
Okidata ... 1 year	
5093 OL400 Laser Printer 599. 9590 OL810 Laser 969.	
11901 OL830 Plus..... 1149. 11893 OL850.....	1279.
Pacific Data ... 60 day MBG	
5729 ProTracer (personal CAD printer) (1 yr.).....	1099.
Seiko ... 1 year	
1069 Smart Label Printer Plus (Windows or DOS)...	145.
1506 Smart Label Printer Pro (Windows or DOS).....	229.



Logitech ... 2 years
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GRAPHICS

Image-Editing Software

► SUMMARY OF FEATURES

Products listed in alphabetical order

■ = YES □ = NO

PC MAGAZINE
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	Adobe Photoshop for Windows	Image-In-Color	Image-In-Color Professional	ImageWizard	PhotoFinish	PhotoMagic for Windows
Image Management						
Search for image by name/type	□ □	■ ■	■ ■	■ ■	□ ■	□ □
Thumbnail browser	□	□	□	■	■	■
Attach labels to thumbnails	N/A	N/A	N/A	■	□	■
Input Device Support						
Digitizer tablets	Any Pen Windows device	Any Windows device	Any Windows device	Kurta, Wacom	Any Windows device	Wacom
Supports pressure sensitivity	■	■	■	□	□	■
Supports scanners through Twain	■	■	■	■	■	■
Still video cameras	■	■	■	■	□	■
Input device calibration	■	■	■	□	■	■
Output Device Support						
Windows-compatible film recorders/printers	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■
Print options:						
Trim marks/Registration marks	■ ■	□ □	■ ■	□ □	□ □	□ □
Print film negatives/ step scale	■ ■	□ ■	■ ■	□ □	■ ■	□ □
Specify:						
Emulsion orientation	■	□	■	□	□	□
Halftones	■	■	■	□	■	□
Dot shape/Frequency	■ ■	■ ■	■ ■	□ □	□ ■	□ □
Margins	■	□	□	□	□	□
Resolution	■	□	□	■	■	■
Output device calibration	■	■	■	□	■	■
Color separation	■	□	■	□	□	□
Independently specify CMYK channels (frequency and angle)	■	N/A	■	N/A	N/A	N/A
Print individual plate/black plate	■ ■	N/A	■ ■	N/A	N/A	N/A
Under-color removal (UCR) and black generation	■	N/A	■	N/A	N/A	N/A
Dot-gain/ink compensation	■ ■	□ □	■ ■	□ □	■ ■	□ □
Gray-component replacement (GCR)	■	□	■	□	□	□
Documentation and support						
Tutorial	■	■	■	■	■	■
Free technical support (eastern time)	9:00-8:00 M-Th; 9:00-5:00 F	10:00-7:00 M-F	10:00-7:00 M-F	Noon-8:00 M-F	9:00-6:00 M-F	24 hrs. M-F; 9:00-6:00 Sat.-Sun.
BBS	CompuServe	Company-run	Company-run	Company-run	Company-run, CompuServe	Company-run, CompuServe

N/A—Not applicable. The product does not have this feature.

face seems clean and simple. Although it provides palettes for brush, color, and object-attribute control, you spend most of your time with a simple seven-button toolbar and a fairly standard set of pull-down menus.

Most of PicturePro's tool set is also straightforward, although it includes some functions more common to paint programs than to image-editing software. It supports a variety of natural-media brushes, a rich selection of filters, a text tool that works with TrueType and Adobe Type 1 fonts, and good color-control mechanisms.

PicturePro also includes a number of less common power features. It lets you

use brush pressure, direction, or velocity to control parameters such as ink transparency, color shift, and paper penetration. It can add, subtract, and intersect masks, save them to disk, and convert

them to vector objects. An on-screen densitometer displays graphical RGB and CMYK breakdowns of any color under your cursor.

Perhaps PicturePro's most impressive features are its powerful object-drawing tools, which allow you to create, fill, and layer geometric shapes and edit them as Bezier curves. You can even fill these shapes with bitmap images, so you can move layers of bitmaps around the canvas as though they were vector objects.

CLOSE, BUT NO CIGAR

With such a powerful combination of image-editing, painting, and vector-drawing features, PicturePro sounds like

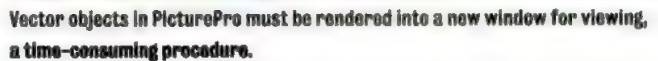
SUITABILITY TO TASK

Ventura PicturePro

	POOR	FAIR	GOOD	EXCELLENT
Photo retouching	●	●	○	○
Creative editing	●	●	●	○
Professional imaging	●	○	○	○
Output	●	●	●	○
Image management	●	●	○	○

Image-Editing Software

on-line Help isn't indexed particularly well, and the manual is terse at best. As a result, functions that should be relatively easy to learn—like monitor calibration and bitmap layering—turn into frustrating egg hunts. At times, we actually needed Ventura technical support to help us locate documented features that were hidden in unexpected places.



In addition to interface inconsistencies, PicturePro's ease of use was also less impressive than we expected. Some of the features that PicturePro shares with Photoshop and Fractal Design Painter don't work as smoothly here. In our testing, selections didn't paste as seamlessly as they should have, filters required more tweaking, and brushes didn't feel as natural as in those programs. Many dialog boxes have no Help or Preview buttons and some don't retain their previous settings, forcing you to enter the same values repeatedly during repetitious tasks. Furthermore, PicturePro doesn't support JPEG file compression or Kodak Photo CD format, both of which should be standard on a professional-level image-editing package.

While the object-drawing tools are a nice feature, they're slow, and in our testing we found that the interface between bitmap and vector layers is cumbersome. But worst of all, the program displays vector objects as outlines, which undermines their effectiveness for manipulating layers of bitmaps. To view our finished test objects, we had to render them first, which proved to be a time-consuming procedure that caused the entire image to redraw in a new window.

Professionals concerned about producing color-accurate separations will also be disappointed by PicturePro's limited CMYK editing capabilities. Even if you incur the expense of creating an image on a CMYK scanner, you won't be

able to edit it until you perform a potentially color-degrading conversion to RGB. This posed a major problem when we were trying to complete the professional-level composite image portion of our tests.

The program's biggest problems, though, are related to performance and stability. Despite claims to the contrary in Ventura's literature, PicturePro was unable to reliably use Twain to run our Microtek Scanmaker II. In fact, we never did succeed in getting an accurate scan

Ventura PicturePro, Version 1.1

*Ventura Software Inc., 15175 Innovation
Dr., San Diego, CA 92128; 800-822-8221,
619-673-6000; fax: 619-673-7784*

List price: \$795

Requires: 386-based PC or better (486 recommended), 4MB RAM (6MB or more recommended), 6MB hard disk space (10MB or more recommended), EGA display or better (24-bit SVGA recommended), DOS 3.3 (DOS 5.0 recommended), Microsoft Windows 3.x (Windows 3.1 recommended), mouse (a Twain-compatible scanner, PostScript image-setter, and pressure-sensitive digitizer tablet are recommended)

In short: While Ventura PicturePro is a fundamentally sound program with powerful editing tools, its sluggish performance and oddly organized interface overmatch its strengths, making professional image-editing tasks more time-consuming than they should be.



it ought to be an unqualified winner. It's not until you actually use the program that the unpleasant surprises begin. The first thing you notice is that common functions are sometimes in the wrong places. Cut, Copy, and Paste are in the Edit menu, where you'd expect to find them, but Flip Horizontal/Vertical isn't with the other translation and rotation tools in the Transform menu—it's buried three levels deep under the Image menu. To save a canvas in a different format, you select Export from the Files menu, but if you want to save only a portion of the image, you use the Windows menu.

This problem is compounded by weak documentation. There's no tutorial, the

Announcing the first network printer



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Microsoft®	*802.3
LAN Manager	Token Ring (4/16Mbps)
Windows for Workgroups	*802.3
Windows NT	Token Ring (4/16 Mbps) *802.3
IBM LAN Server	Token Ring (4/16 Mbps) *802.3
AppleTalk	*LocalTalk *EtherTalk
HP-UX**	*Ethernet
SunOS**	*Ethernet
Solaris**	*Ethernet
SCO UNIX®	*Ethernet

*Standard in the HP LaserJet 4Si MX printer. **For operating HP-UX, SunOS or Solaris, a one-time purchase of \$189 in configuration software is required. Adobe and PostScript are trademarks of Adobe Systems Inc. which may be registered in certain jurisdictions. Microsoft is a U.S. registered trademark of Microsoft Corporation. UNIX is a registered trademark of UNIX System Laboratories Inc. in the U.S.A. and other countries. *In Canada call 1-800-387-3867, Ext. 7299 © 1993 Hewlett-Packard PE12353

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What's more, HP's LaserJet 4Si MX printer is ready to handle whatever needs come down the

that adapts to multiple environments.



pike. More operating systems? No problem. As your network system continues to evolve, the capabilities of this printer are no longer just impressive. They're indispensable.

The HP LaserJet 4Si MX printer is loaded with features that define state-of-the-art. HP's enhanced PCL5 and genuine PostScript™ Level 2 software from Adobe™ come standard. Printer environments are saved while switching. Setup is a cinch with network software utilities and drivers included in the box. And, if you need any reassurance about trouble-free operation, you have it in our Simple Network Management Protocol (SNMP) support.

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But what if you don't need the full capabilities of the HP LaserJet 4Si MX printer right away? HP offers another printer that's probably a perfect fit. The HP LaserJet 4Si printer delivers the identical 17 ppm performance and superb 600 dpi print quality. It also has room to grow. The two MIO expansion slots let you add

HP JetDirect network interface or third party cards. And you can add on Adobe's genuine PostScript Level 2 software and SIMM memory modules, as you need them.

To find out more about the multiple-network HP LaserJet 4Si MX printer and the upgradeable HP LaserJet 4Si printer just call 1-800-LASERJET, Ext. 7299.† Capabilities this advanced make a world of difference—in any environment.



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during our tests. The program was sluggish in general (it took an average of almost 19 minutes to complete our Motion Blur test on the 64MB test-bed), and we frequently ran into a bug that caused it to slow to a tenth of its normal speed. Ventura hopes to correct this problem and the Twain problem (and automatically update registered users) by the time you read this review.

Reliability proved to be a constant problem. PicturePro crashed randomly every 20 minutes or so on our 16MB test machine. By updating our video driver and moving to a 64MB computer, we reduced the number of crashes, but the program never ran without interruption for more than a few hours.

The bottom line for any automation tool is the amount of time that it helps you to trim from the production cycle. PicturePro, with its broad functionality and sophisticated user interface, should be able to streamline just about any type of image-editing task that is likely to arise at a service bureau or pre-press shop. But PicturePro 1.1's eccentric organization, performance problems, inadequate documentation, and buggy operation all combine to make it a rather poor way to meet a deadline. It slowed us down so much, in fact, that we were unable to complete our tests in nearly twice the normal evaluation time.

The state of Ventura PicturePro, Version 1.1, is especially unfortunate because the basic program is fundamentally sound. It has plenty of potential, but this version leaves you truly disappointed in the end. The next release may be the winner this one should have been—but for now, you will be better off choosing a more mature product.

RIX SoftWorks Inc.

WinRIX

BY OLIVER RIST

RIX SoftWorks is marketing WinRIX, Version 1.2, as a high-end image editor. Unfortunately, the absence of a few key functions keeps WinRIX from meeting that standard. But if all you need to do is some simple image editing and vector-based drawing, this \$395 package may be worth the investment.

For business users, there is a degree of logic behind focusing WinRIX on both vector and raster graphics. You'll find a functional set of painting tools as well as vector drawing tools such as Bezier curves and overlay grids. WinRIX also offers a few niceties, such as preview test swatches for some filter adjustments.

ERRORS OF OMISSION

WinRIX's fatal flaw, however, is the conspicuous absence of several key functions that should automatically be included in any professional-level image-editing package. It doesn't, for example, allow you to calibrate your monitor. You'll also have to do without hue and saturation adjustments—which are

SUITABILITY TO TASK

WinRIX

	POOR	FAIR	GOOD	EXCELLENT
Photo retouching	●	●	○	○
Creative editing	●	●	●	○
Professional imaging	●	○	○	○
Output	●	○	○	○
Image management	N/A			

among the more valuable functions for color professionals.

Although WinRIX can convert files to CMYK, it can neither read these files nor convert them to RGB. If you want to edit these files, then you will have to split them into separate channels and then work on each of the channels individually, making this task unnecessarily time-consuming for imaging professionals. Furthermore, although WinRIX supports most of the common image file formats, it can not handle EPS or JPEG files—both of which are important to desktop publishers and imaging professionals alike.

On the positive side, while WinRIX's list of directly importable file formats comes up a little bit short, the program does include its own screen-grabbing utility—called SnapRIX—which allows you to capture some images that might not otherwise be directly saved to the Windows Clipboard.

Though WinRIX calls its copy and paste operations "merges," its controls

Image-Editing Software

are more in line with those offered by other image-editing packages. You can't adjust individual color channels during a merge, nor can you save a mask. The Merge Contol dialog does give you choices for adjusting the feathering and transparency of a merge, however, and also allows you to select lighter or darker pixel ranges to acheive a better blend when pasting in parts of a composite image. WinRIX also makes an effort to satisfy both neophytes and experts by providing simple and complex methods

*In WinRIX's tool
adjustment boxes you
will find test swatches
taken from the
active image you're
editing.*

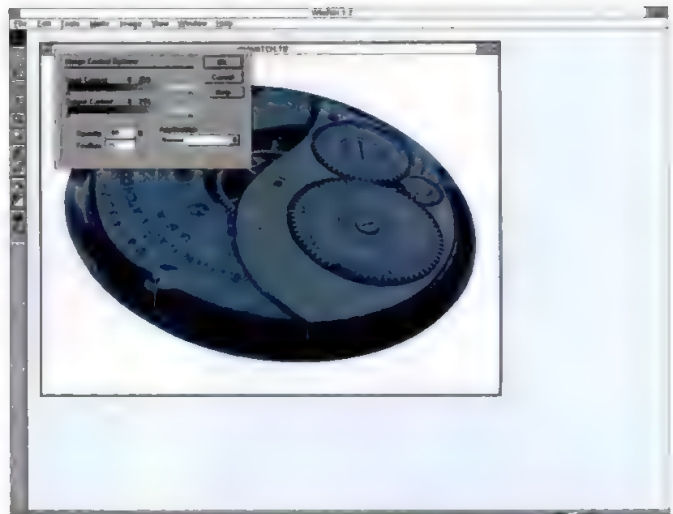
of adjusting brightness, contrast, and color values. Simple adjustments are made via point-and-click or with easy-to-understand slide-rulers; complex adjustments require the user to input numeric values directly.

WinRIX's tool-adjustment boxes are helpful as well. Here you will find test swatches taken from the active image you're editing, giving you a better idea of the effect a particular filter or tool will have. For instance, while we were creating the composite image in our testing, adjusting WinRIX's Diffusion filter on the watch to achieve the desired effect was easy. However, you must be careful when using this feature: We managed to crash WinRIX more than once, especially when using the Magic Wand tool and while running complex cut-and-paste procedures with multiple-image windows open. Many of these problems may have been due to faulty memory management. With more than two sizable images open, the package would give us an "Out of Memory" message. WinRIX was also painfully slow in some of our performance tests: It couldn't perform a motion blur on either of our test-beds, and its average time in performing an arbitrary ro-

tate on our 16MB machine was an abysmal 474.79 seconds (only Photo-Magic was slower).

LIMITED FLEXIBILITY

WinRIX's image-editing tools provide some of the features found in competing products, though certainly implemented differently and sometimes with some disappointing limitations. Selection tools, for example, include all the basics (ellipse, lasso, rectangle, and magic wand) and allow you to enlarge or shrink your selections, but you can't otherwise change the shape of these selections. While these adjustment capabilities are useful and work as they should, the ability to edit the Bezier curve of the mask would seem like something a professional-level package should offer. Furthermore, a square background is permanently attached to your selection even if it's an ellipse or lasso. To get rid of this you've got to go into the Edit menu and



WinRIX's Merge Control dialog provides flexibility in making adjustments for combining images.

set Transparency to "Automatic." While this isn't crippling, it's certainly not intuitive.

Some of Version 1.1's flexibility has been lost in the latest version of WinRIX. The previous release provided its own scanner controls, while Version 1.2 relies on Twain support. The new package had some serious problems working with our Twain driver. We had difficulty scanning the gray-scale images from our tests. Sometimes the images came in solid black, and sometimes they came in as negatives of themselves.

The flexibility of WinRIX's selection of paint and text tools is likewise limited. You can adjust the feathering on the edges of brush strokes but not the fade out along their edges. The package can handle any Windows-compatible fonts, however, and fully supports anti-aliasing.

WinRIX's ability in the area of gray-scale image editing is far more disappointing. When we tried to convert a color image to gray-scale, we got horrible results. The resulting gray-scale image was so grainy and muddy that it was almost unusable. Look elsewhere if you need to convert color photos to grays.

As a professional-level image editor, WinRIX leaves something to be desired. It's missing some important functions, and its performance is too erratic to recommend it for anything but occasional, casual use. At this price, though, it may be worth the investment if you need support for vector and bitmap graphics. □

FACT FILE

WinRIX, Version 1.2

RIX SoftWorks Inc., 18023 Sky Park Circle,
Suite J, Irvine, CA 92714; 714-476-8266; fax,
714-476-8486

List price: \$395

Requires: 286-based PC or better, 2MB RAM (8MB recommended), 2MB hard disk space (10MB recommended), VGA display or better (SVGA or better recommended), DOS 3.3 (DOS 5.0 recommended), Microsoft Windows 3.1, mouse

In short: Because of its minimal file format support, poor gray-scale conversion, rather inflexible selection of paint and text tools, and limited ability to edit in CMYK mode, WinRIX, Version 1.2, falls short as a professional-level image-editing package. But at \$395, its combination of vector- and raster-based tools and its helpful tool-adjustment boxes should suffice for many business applications.

 ON READER SERVICE CARD

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A megabyte isn't what it used to be. When the AT, with its 20MB hard disk, was introduced in 1984, you could fit a state-of-the-art spreadsheet or word processing program in half a megabyte and still have room for data.

Today's disk-hungry Windows applications can take up 10MB to 15MB each. And as word processing, database, and spreadsheet files have begun to incorporate fonts, graphics, and even sound, data files have also grown in size.

If you want the functional equivalent of the AT's 20MB hard disk today, you probably need something closer to 300MB. If you're a power user, you should opt for 600MB.

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by M. David Stone

And if you're a super-power user or configuring a file server for a small-to medium-size network, you should set your sights in the 1GB to 1.5GB range.

Fortunately, as program and data files have grown over the last few years, the per-megabyte price of a hard disk has shrunk dramatically. The first 10MB hard disks available for IBM personal computers were priced between \$4,000 and \$4,500, or about \$400 to \$450 per megabyte. The nine 1GB to 1.6GB drives we tested for this feature were list-priced from \$1,475 to \$2,130, or \$1.20 to \$1.97 per megabyte. And street prices come even closer to the magic figure of \$1 per megabyte. According to Hard Drives International, a direct marketer of hard disks, as large hard disks become more popular and manufacturers succeed in packing even more data onto fewer platters, prices for 1GB drives can be expected to fall to below \$800 by mid-1994, or \$0.80 per megabyte. While a single power user might opt for a 1GB to 1.6GB hard disk to hold many CAD or sound files, today drives of that size are more likely to be used for a network file server.

RAID OR SLED?

If you're configuring a file server, you have a choice between two types of hard disk configurations: RAID (Redundant Array of Inexpensive Disks) and SLED (Single Large Expensive Disk). A RAID system consists of a number of hard disks connected to a single controller that allo-



EDITORS' CHOICE

- **Adstar IBM 0662 Model S12**
- **Maxtor MXT-1240S**

If you're looking for a 1GB to 1.6GB drive for your power system or file server, you won't go wrong with any of the nine drives reviewed here. With two exceptions, they use similar technology, offer good performance, and are reasonably priced. Two products stand

out for performance and value: the Maxtor MXT-1240S and the Adstar IBM 0662 Model S12.

The Maxtor drive has a spin rate of 6,300 rpm, compared with the 5,400 rpm of the other drives. This rate translates to faster seek and access times, and the Maxtor consistently generated excellent performance on our throughput tests. It placed first on the Random

Read test for the two block sizes and on the Sequential Read test for the 4K block size; it also gave above-average performance on all the other tests. Combine top-notch performance with a street price approaching \$1 per megabyte and you have an excellent buy.

The Adstar IBM 0662 Model S12 also proved an excellent performer, coming in a close second or third on all

cates data across the drives. There are five standard RAID configurations (RAID Levels 1 through 5), each of which produces varying degrees of data redundancy and drive performance. RAID 1—simple disk mirroring—keeps a full copy of all your data on a second drive. The other RAID standards spread data and parity across the drives in various ways to maximize performance and reliability. RAID's biggest advantage is data redundancy, which lets you access all your data even if one drive fails. Many

RAID systems let you replace one disk without shutting down the entire network. For large networks in which a shutdown would leave hundreds of people unable to work, RAID is the preferred solution.

However, the more sophisticated versions of RAID are far more expensive than single, so-called expensive disks. And price is the main argument in favor of a single-disk solution. The six RAID packages we recently covered ("RAID to the Rescue," *PC Magazine*, September

HIGHLIGHTS

Large Hard Disks

A GIGABYTE OF STORAGE is the right fit for a power user's dream machine or for a file server on a small- to mid-size network.

LARGE HARD DISKS are slightly less secure than RAID systems but much less expensive: Street prices for 1GB to 1.6GB disks are now as low as \$1 per megabyte and continue to fall.

MIRRORED DISKS can help keep your data secure at a far lower cost than

advanced RAID subsystems. The least expensive solution is using two SLEDs and NetWare's RAID 1 mirroring.

SCSI-2 INTERFACES promise better compatibility and performance than SCSI-1. Many of the disks we reviewed are available in Fast and Wide SCSI.

SIMILARITIES OUTNUMBER differences among the nine reviewed disks. Physical characteristics such as platter size, rotational speed, and average

seek times are nearly identical; benchmark test results were also similar. Warranties and service may vary, but buying a disk as part of a computer system may negate these policies.

IBM'S ADSTAR division is positioning itself as a technology leader. Thanks to its PRML technology, high-density media, and special magnetoresistive read/write heads, the 1.05GB IBM 0662 drive is a mere inch thick and uses only three platters.

Large Hard Disks

our performance tests. But where the Adstar IBM stands out most is in its use of cutting-edge technology. In contrast to the seven or eight platters packed into the other drives, the Adstar's use of PRML (Partial Response Maximum Likelihood) technology and magnetoresistive heads lets it pack 1.05GB into three platters in a 1-inch-high case. Adstar also projects 800,000 hours of mean time between failures—more than twice that of most of the others hard disks.

HONORABLE MENTION

The Conner BAJA CP-31370 was also a top performer, with first-place scores in the Sequential and Random Write tests for both block sizes. Where Conner falls short is in its high street price and two-year warranty. But keep in

mind that street prices are always changing, and you may find this drive for less than \$1,800.

Honorable mention goes to every other drive reviewed here as well, since they all showed good performance on our benchmark tests. With the exception of the Maxtor and Adstar IBM, all the drives have similar specs and construction. Unlike most of the other reviewed drives, whose platters spin at 5,400 rpm, the Quantum ProDrive 1225 spins at 4,500 rpm, which explains why its performance was at the low end of the drives reviewed here. But the Quantum's performance was still adequate, and Quantum plans to introduce a faster drive this fall. If you can find any of the nine drives reviewed here at a reasonable price, you probably will not be disappointed.

14, 1993) ranged in price from \$15,800 to over \$66,686 for 4GB to 8GB arrays, with a price-per-megabyte range of \$3.95 to \$16.67. This makes RAID expensive for a small- to medium-size network.

Compared with RAID, the disadvantage of a SLED is obvious: Not only do you have to rely on your backups to recover from a dead or damaged disk, but you risk losing everything you worked on since the last backup. A relatively inexpensive alternative is a disk-mirroring system using two SLEDs (or RAID 1), which you could acquire for \$2,500 or less. RAID 1 uses a single controller for both disks. This capability is actually built into NetWare; compared with other RAID configurations, it is relatively straightforward and inexpensive. Your criteria for assessing two hard disks for disk mirroring are the same as those for judging a single disk, and you can choose a model based on our comments here and simply buy two of them.

REVIEW CRITERIA

To be included in this review, a drive had to offer 1GB to 1.6GB formatted capacity and support the Fast SCSI-2 specification. It also had to be available as an internal model and had to be shipping in quantity as of April 30, 1993. For drives

that include an on-board cache, the cache size had to be a minimum of 128K. All of the drives have a 3.5-inch form factor, though this wasn't a requirement.

We chose SCSI drives because they are the type most commonly used in high-capacity drives. SCSI-2 is a relatively new version of SCSI that both speeds data throughput and helps clear up the compatibility problems associated with PC-based SCSI-1 technology. With its more tightly controlled command language, SCSI-2 leaves less room for vendor-specific host adapters than SCSI-1 did.

SCSI-2 also adds speed with its Fast, Wide, and Fast-Wide protocols. *Fast SCSI* can achieve data-transfer rates as high as 10MB per second over an 8- or 16-bit data path—twice the speed of the

original SCSI. *Wide SCSI* offers a 16- or 32-bit data path and transfer rates up to 20 or 40MB, and it can be coupled with Fast SCSI. Assuming that you have the correct drivers, SCSI-2 and SCSI-1 peripherals can be linked in the same chain. (For a detailed discussion of the current state of SCSI, see "Fast and Flexible: SCSI Technology Grows Up," in *PC Magazine*, June 29, 1993.)

Nine manufacturers were shipping at least one drive that met these criteria. Where a manufacturer offered more than one, we picked a representative model. The nine drives reviewed here are the Adstar IBM 0662 Model S12, Conner Peripherals BAJA CP-31370, Digital Equipment Corp. DEC DSP3160, Fujitsu M2694ESA, Hewlett-Packard HPC2247, Maxtor MXT-1240S, Micropolis Model 2112, Quantum ProDrive 1225, and Seagate Technology ST11200N.

Toshiba's 1.36 GB MK-538FB drive also fit our criteria, but the company was unable to get one to us in time for testing. Seagate says its new Barracuda 1 is faster than the Seagate drive reviewed here, but unfortunately, it released the drive too late for our testing. And Quantum plans to release a new SCSI-2 drive in the fall that it claims will perform better than the model reviewed here.

*For this feature, we
chose SCSI drives
because they are the type
most commonly used in
high-capacity drives.*

WHAT WE FOUND

We found remarkable similarity both in the technology and the performance of the nine drives we tested. While further technological advances are ahead (see the sidebar "Packing In More

Data"), they are likely to happen in small increments. Our test results closely match the claimed specifications for the drives. Most have an *average seek time* (the average time needed to move the head across the disk to a particular track) of 10 milliseconds, and most rotate at

Our Contributors: LEON ERLANGER is an associate editor of *PC Magazine*. MICHAEL ZULICH is a project leader at *PC Magazine*. CATHERINE KUNKEMUELLER is a staff editor at *PC Magazine*. MARY E. BEHR, and MEREDITH M. GADSBY are editorial researchers at *PC Magazine*. ALFRED POOR and M. DAVID STONE are contributing editors to *PC Magazine*. JAMES KARNEY is a frequent contributor to *PC Magazine*.

HARDWARE

Large Hard Disks

5,400 rpm. For these drives, 5,400 rpm translates to an *average latency* (one half the time needed for a single rotation of the disk) of 5.6 ms. And that gives most of the drives an *average access time* (average seek plus average latency) of 15.6 ms. So, given such similar specifications, it's not surprising that most of the drives have similar performance.

The two notable exceptions are the Quantum ProDrive, whose relatively slow rpm rate (4,500) caused slower-than-average performance, and the Maxtor drive, whose faster-than-average seek time and faster rpm rate (6,300) gave it above-average performance. Another good performer, the Conner drive, managed to turn in some of the best results on our Random and Sequential Write tests despite having just an average 5,400 rpm rate. According to Conner, its good performance is due to the efficient algorithms used by its segmented cache.

The reviews for these drives are short because there isn't that much to differentiate the drives from each other. Physically, for example, all have a 3.5-inch form factor, and all have a height of 1.6 inches except for the IBM, which has a 1-inch height.

The technology of these drives is also similar. All use RLL encoding and multiple zone recording (see the illustration on this page)—a scheme that increases drive capacity by putting extra sectors in the outer tracks of the drive. Most offer either 7 or 8 platters with 13 to 15 read/write heads (the exception here again is IBM, which uses new technologies to store all its data on 3 platters with 5 heads). And all use a combination of a segmented and look-ahead buffer. Both types of buffers read additional data ahead of the data being requested and store it in RAM for quick retrieval. Segmented buffers divide the buffer RAM into smaller buffers in order to store data from several reads. Most of the drives also offer adaptive buffering, which allows the drive to adjust the number and size of the buffer segments. Test results did not vary greatly among drives

These drives are surprisingly similar, and no single vendor has a significant edge on performance.

with 256K and 512K buffers; many other factors affect performance.

One of the few differentiating features among these drives is the warranty, which ranges from two years to five. Note, however, that the warranty shown in the features table is not necessarily the one you'll wind up with if you buy the drive as part of a system. The general rule is that the computer vendor determines the warranty length for the drive.

Ultimately, these drives are surprisingly similar, and no single vendor has a significant edge on performance. What real differences there are relate to mixes of performance, price, and capacity. You won't go far wrong with any of the nine drives we've reviewed, but you're likely to find some mixes that are more to your liking.

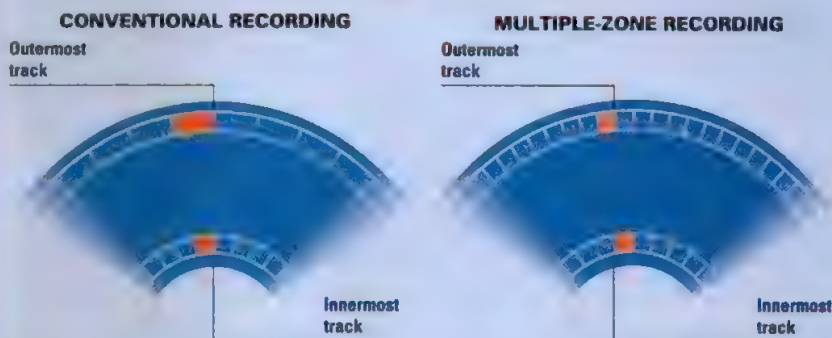
Adstar

Adstar IBM 0662 Model S12

BY JAMES KARNEY

IBM's Adstar OEM storage division is showing promise with an initial line of 1-inch-high large-capacity hard disks. The Adstar IBM 0662 Model S12 we tested is a 1.05GB unit that contains only three

Maximizing Disk Capacity



Older hard disks used inexpensive recording techniques that required all tracks to carry the same number of sectors, like the illustration on the left. Today's drives come with intelligent buffers that can compensate for variations in data-transfer rates across a disk platter, allowing for progressively greater numbers of sectors per track as you go from the inner to the outer tracks. Shown in the illustration on the right, multiple-zone recording allows for greater data density and faster data transfer.

platters. On PC Labs' tests, the IBM 0662 proved itself a strong performer.

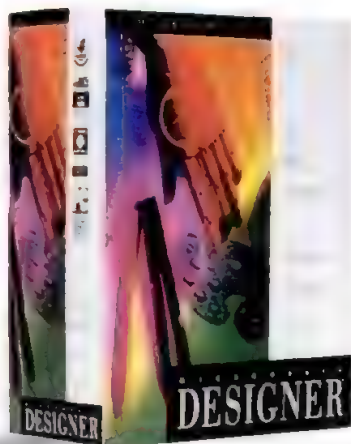
This SCSI-2 drive is being offered in four models that differ according to the size of the data path and noise reduction: Fast SCSI-2 single-ended, Fast SCSI-2 differential, Fast-Wide single-ended, and Fast-Wide differential. Since SCSI-2 differential offers more immunity to line noise than does single-ended SCSI, it allows longer cabling. Wide SCSI has a 16-bit data path in contrast with Fast SCSI's 8-bit data path. We reviewed the single-ended Fast SCSI-2 version.

As with most drives in this class, the IBM 0662's 5,400-rpm spin rate yields better performance than older SCSI and ESDI high-performance drives do. Average seek time is rated at a speedy 8.5 ms, and the drive has a 512K cache with a multisegmented look-ahead architecture. Spindle synchronization makes it suitable for advanced RAID configurations.

On PC Labs' tests, the IBM 0662 performed extremely well, achieving scores that were close to those of the 6,300-rpm Maxtor MXT-1240S. With the exception of its average performance on the Sequential Write test (both block sizes), the IBM 0662 placed second or third on all of PC Labs' throughput tests.

The IBM 0662 is one of the first drives on the market to feature Partial Response Maximum Likelihood (PRML) technology and magnetoresistive heads: two new technologies that allow tighter packing of data

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Benchmark Tests: Large Hard Disks

What the Numbers Mean

Average throughput on both the Sequential Read and the Sequential Write tests was good for all the drives. The DEC DSP3160 stood out on the 512-byte Sequential Read test, with a throughput of 332.6 kilobytes per second, a result due to the drive's efficient caching algorithms and extremely low seek times. The Adstar IBM 0662 Model S12 and the Maxtor MXT-1240S followed close behind, with throughputs of 322 KBps and 289 KBps, respectively.

The Conner BAJA CP-31370 achieved the fastest speeds on the two Write tests. Conner attributes this fast performance to its proprietary write algorithm.

The Maxtor had the best scores on our two 4K Read tests and on the 512-byte Random Read test; it also placed second-fastest on the two Write tests. Its fast 6,300-rpm spin rate minimizes delay while the platter spins into the correct position. By contrast, the 4,500-rpm Quantum ProDrive 1225 placed last on all our throughput tests.

How We Tested

We tested the performance of each SLED unit in a file server on a small NetWare 3.11 network. The server was a Compaq Deskpro 486M with

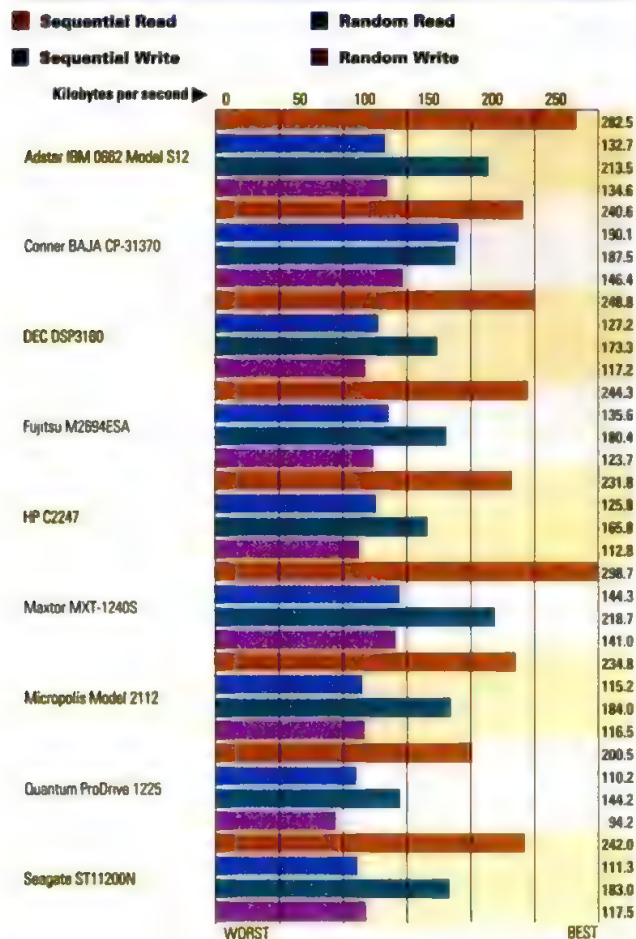
16MB of RAM and a 16-megabit-per-second EISA Token-Ring adapter from Proteon. Eight workstations—each one a Compaq Deskpro 486M with 8MB of RAM—were attached on a single network segment.

We divided each SLED into four NetWare volumes and filled each one to 50 percent of capacity. Using Version 2.06 of ZD Labs' NetBench test suite, we monitored performance while the workstations created, wrote, and read files of various sizes. Here we report the throughput rate, in kilobytes per second, for a 4MB file accessed with a 512-byte block size and a 4K block size.

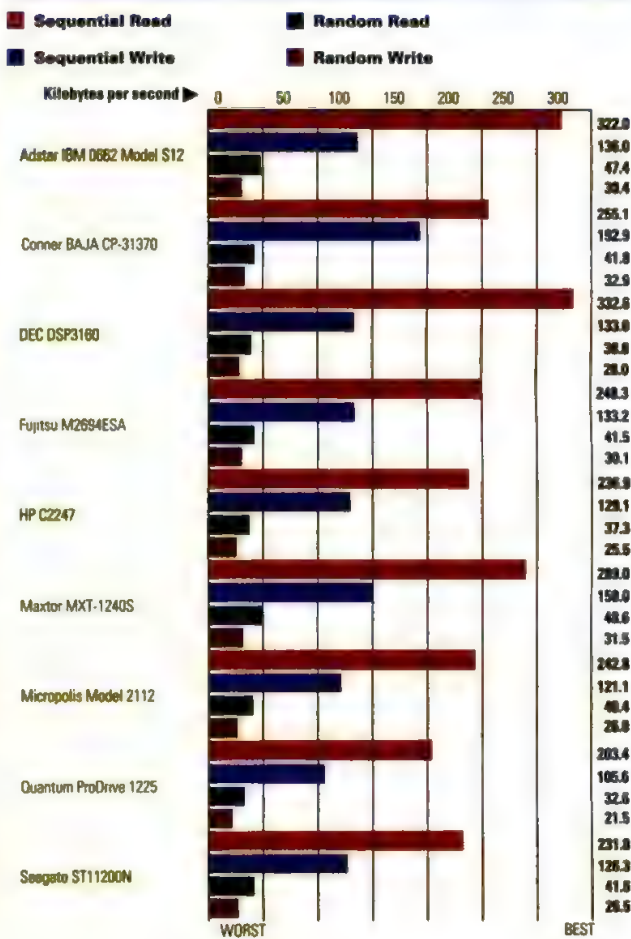
During the **Sequential Read** and **Sequential Write** tests, the test station creates a file on the server which it then reads or writes, a block at a time, from beginning to end. On reaching the end-of-file indicator, the test starts over from the beginning; this process continues for 10 minutes. The Sequential Read and Sequential Write scores indicate how effectively the disk streams data off the drive.

The **Random Read** and **Random Write** tests access single blocks non-sequentially within a file created on the server. The relative position of each read or write is randomly determined by the test station. Random reads and writes are performed for 10 minutes, and we measure the throughput rates.

Throughput (4MB file, 4K blocks)



Throughput (4MB file, 512-byte blocks)





The Choice Is
No Longer
Black And White.



is one of the thinnest color notebooks on the market — 1.77 inches. Its footprint measures only 11.7 x 8.5 inches, and it weighs under 5.7 pounds.

486 Power

You don't have to sacrifice performance to have color, either. ColorBook models are based on SL Enhanced Intel486® CPUs. Both ColorBook models include a floppy drive, 4MB of RAM (upgradeable to 20MB), and a large, fast removable hard drive. These notebooks are powerful enough to become your only computer!

Integrated Track Ball And PCMCIA Slots

The ColorBook includes a built-in track ball, which is much easier to use than a mouse in most portable situations. You also get two PCMCIA Type II card slots so you can plug in dozens of available PCMCIA peripherals.

Greener Pastures

The grass is greener on the ColorBook side of the fence! It's an extraordinary value even by Gateway's standards — and we wrote the book on value! We have a reputation for offering the best prices on high-quality products with exceptional service from friendly folks in the Midwest. That's why the choice of a computer supplier is black-and-white, even when you're buying a color notebook! Give us a call.



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Inverted Foldout slip-sheet

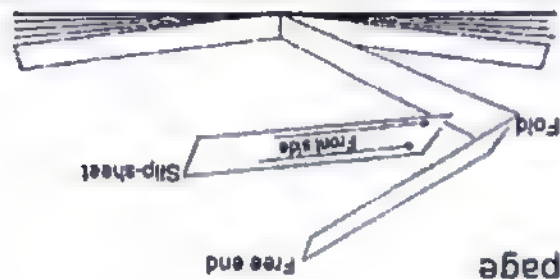
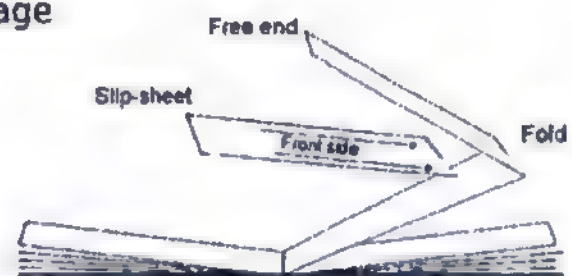


GbsSlipSheet-001

Folded edge of the page

Foldout slip-sheet

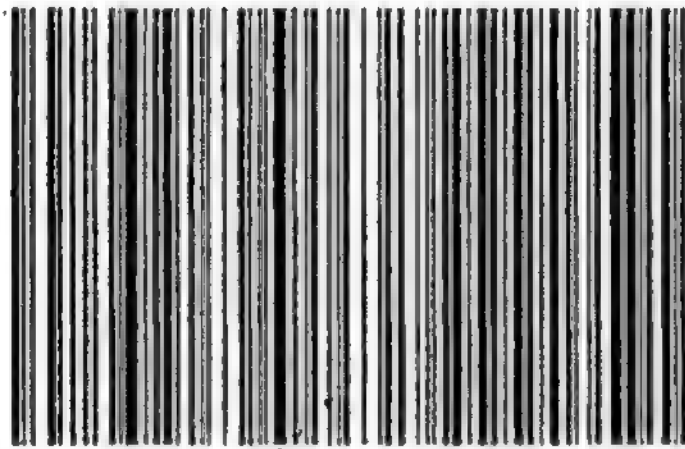
1. Open the foldout page
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 1. Front side touching the free page
 2. Arrow pointing to the fold
3. Slice the folded edge
4. Close the page and slip-sheet



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3. Slice the folded edge
4. Close the page and slip-sheet

1. Follow instructions on the other side

Inverted Back



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Back

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Introducing The ColorBook!



For the same money, you can have a black-and-white 486 notebook. Or you can have a color 486 notebook. Which is it going to be? Hay, it's not too hard to spot the best deal: the ColorBook from Gateway 2000! The new ColorBook has everything you're looking for in a portable at a price you'd expect to pay for a monochrome system. That's a special breed!

Exploding The Myth

Why do you expect to pay so much more for a color portable? Because other manufacturers always charge a plump premium for color. They've been milking the market, brainwashing you into thinking high-quality color costs a lot more to manufacture. It doesn't! We're selling the ColorBook for our usual cost-plus-small-margin. Now other companies will have a hard time perpetuating the color portable price myth. (Competitors absolutely *hate* us! Isn't it great?)

Experts' Reaction

We gave several PC trade publication editors a sneak preview of the ColorBook. Here's what they said about it: "Way cool!" "Dead on." "You won't be able to make enough of these."

Dazzling Color Display

The editors were impressed by the bright, crisp color graphics from the latest-technology, dual-scan STN display. It's a 9.4-inch VGA LCD, backlit for use in any lighting conditions. The editors said the ColorBook has the best STN color display they had ever seen! When they learned one model was priced *less than \$2,000*, they were convinced the ColorBook will cause a stampede in the industry.

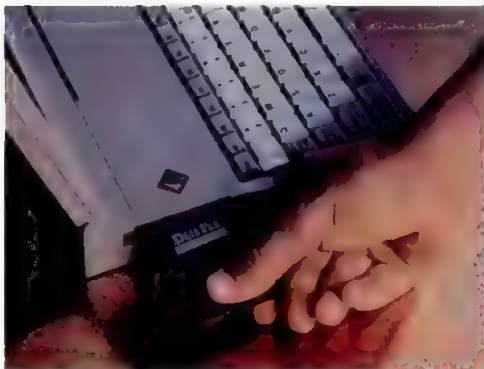
No Compromise On Size

Adding color to a portable usually means adding weight and bulk. Not so with the Gateway 2000 ColorBook. The ColorBook

Introducing The ColorBook!



The ColorBook is one of the thinnest color notebooks on the market — 1.77 inches. Its footprint measures only 11.7 x 8.5 inches, and it weighs under 5.7 pounds.



You'll appreciate the convenience of using PCMCIA cards. They're as easy to carry as credit cards, and they plug right into your ColorBook.



The integrated track ball slides out from a compartment by the space bar on the keyboard. You simply pull it out and go to work. Finished? Just slide the track ball back into the ColorBook.

FEATURES

Size

With the ColorBook, you get great color at a great price while maintaining excellent portability.

SL Enhanced Intel 486® Processor

ColorBook notebooks are based on Intel's new SL technology 486 microprocessors, which makes them powerful enough to serve as your desktop PC with an external mouse, keyboard and monitor. Supports simultaneous video on an external monitor at 640 x 480 resolution.

Dual-Scan STN Color Display

Dual-scan STN color is the latest technology in portable color displays, and it looks fabulous! You get 256 colors with the ColorBook running in VGA mode.

PCMCIA Type II Slots

Add a modem, network card or any of dozens of available PCMCIA-compatible peripherals. The ColorBook's two Type II slots can also be used for one Type III PCMCIA card.

COLORBOOK

- Weight: Under 5.7 Lbs.
- Dimensions: 11.7" x 8.5" x 1.77"
- SL Enhanced Intel 486 Processor
- 4MB RAM (expandable to 20MB)
- 3.5" 1.44MB Diskette Drive
- Removable Hard Drive
- 9.4" Backlit VGA Dual-Scan STN Color Display
- NiMH Battery & AC Pack
- Suspend/Resume Feature
- 2 PCMCIA Type II Slots
- Integrated Track Ball (2 Buttons)
- 85-Key Keyboard
- Parallel, Serial & PS/2 Mouse Ports
- External CRT Port
- MS-DOS® 6 and Windows™ 3.1

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Large Hard Disks

by enhancing read/write accuracy. PRML uses a Digital Signal Processor (DSP) to analyze up to 16 points on an analog wave to determine whether it is a real piece of data. Magnetoresistive heads use separate physical heads for reading and writing, with the read head tuned for a slightly narrower path than the write head so that the chance of a read error is reduced.

The IBM 0662 comes with a projected mean time between failures of 800,000 hours—more than twice that of many similar products—and a five-year warranty. If you buy the IBM 0662 as part of a computer system, however, the system vendor decides the warranty. In a field of products with highly similar specifications, the IBM 0662 stands out with its few platters, 1-inch-height, and above-average performance.

► FACT FILE

EDITORS' CHOICE Adstar IBM 0662 Model S12 Adstar, 5600 Cottle Rd., San Jose, CA 95193; 408-284-6039; fax, 408-284-5665.

Estimated selling price: *none (product not directly available to end users).*

Circle 461 on reader service card

Conner Peripherals

BAJA CP-31370

BY ALFRED POOR

Conner Peripherals made its mark on the computer industry by creating tiny hard disks for laptops. Some users may not realize that the company also makes large-capacity drives, such as the BAJA CP-31370, a 1.37GB formatted-capacity drive offered in Fast SCSI-2 single-ended and differential versions, as well as in an IDE configuration. The SCSI-2 differential version reduces line noise, which allows longer cabling. We reviewed the SCSI-2 single-ended version; it performed in the upper tier but has a high price and a scanty two-year warranty.

Since Conner does not sell direct, the unit does not have a list price. Our evaluation unit was \$1,800; mail-order prices range from about \$1,800 to \$1,899, which comes to about \$1.30 per megabyte.

On our throughput tests, the Conner drive had top marks on both the 4K-block and the 512-byte-block versions of the Sequential Write and Random Write

tests, although the Sequential and Random Read scores were closer to average.

The Conner has a 10-ms seek time and a 15.5-ms access time, and it spins at 5,400 rpm. It uses a variable sector size to squeeze data onto its seven platters and allows from 512 to 520 bytes per sector. The number of sectors can vary from 53 to 96 per track. The drive has a 256K segmented look-ahead cache and spindle synchronization for use in advanced RAID systems.

Conner offers toll-free technical support; a BBS operates from 10:00 to 8:00 eastern time Monday through Friday.

► FACT FILE

BAJA CP-31370

Conner Peripherals, 3081 Zanker Rd., San Jose, CA 95134; 800-526-6637, 408-456-4500; fax, 408-456-4501.

Estimated selling price: \$1,800; list price: *none (product not directly available to end users).*

Circle 462 on reader service card

Digital Equipment Corp.

DEC DSP3160

BY JAMES KARNEY

Best known for its VAX systems and, more recently, the new Alpha CPU, Digital Equipment Corp. also supplies hard disks for its own systems and to OEMs. An average performer on PC Labs' tests, the 1.6GB DSP3160 is marketed through the OEM channel rather than sold directly to end users. Our test model had a \$1,699 selling price, which works out to a very reasonable \$1.06 per megabyte.

The 1.6-inch-high, 3.5-inch DSP3160 contains eight platters with 16 heads. It spins its platters at 5,400 rpm and comes configured with a 512K segmented cache buffer. The average seek time is 10 ms, and the average access time is 15.6 ms. Digital claims a mean time between failures of 300,000 hours.

The DSP3160 offers spindle synchronization for use in advanced RAID systems and comes in several configurations,

including single-ended and differential, Fast and Fast-Wide SCSI-2. Differential SCSI-2 offers better noise reduction than single-ended, and Wide SCSI-2 provides

a 16-bit data path as opposed to the 8-bit data path of regular Fast SCSI. We tested the single-ended Fast SCSI drive.

On our tests, the DSP3160 performed in line with the rest of the drives that we tested. The DSP3160 drive scored best on the 512-byte segment of the Sequential

Read test, where it took first place.

Digital offers a five-year warranty on the DEC DSP3160. If you purchase the drive as part of a computer system and the drive fails, Digital will honor the warranty on the drive no matter what the warranty is on the rest of the system.

At 1.6GB, the DEC DSP3160 was the largest drive we tested. It offers solid performance backed by a good warranty.

► FACT FILE

DEC DSP3160

Digital Equipment Corp., 334 South St., Shrewsbury, MA 01545-4195; 508-841-6439; fax, 508-841-6837.

Estimated selling price: \$1,699; list price: *none (product not available to end users).*

Circle 463 on reader service card

Fujitsu Computer Products of America

Fujitsu M2694ESA

BY ALFRED POOR

The 1.08GB Fujitsu M2694ESA has a high list price of \$2,130, but the street price is closer to a competitive \$1,400 and can go as low as \$1,033—close to \$1 per megabyte. Combined with its solidly mid-range performance, this price may attract users looking for a good buy.

Like most of the drives reviewed here, the M2694ESA is 3.5 inches wide and 1.6 inches high. A Fast SCSI-2 drive with a 10-ms seek time, it uses an eight-platter design with 15 read/write heads for data and spins its platters at 5,400 rpm. The sixteenth platter side is reserved for servo information used to position the data

■ Packing In More Data

by Stephen W. Plain

High-end hard disk capacities tend to double about every 18 months, a feat that, until now, has been accomplished by tweaking and tuning a fairly stable and proven technology of reading and writing to aluminum platters with inductive heads. It is becoming increasingly apparent, however, that current technology is reaching its limits and that new, fairly radical changes will be needed to effect such quantum leaps in capacity in the future.

To allow for acceptable tolerances, most disk drives fail to exploit the full theoretical capacity of their disk media. Several emerging technologies are attempting to gain more disk capacity by increasing the accuracy of read/write mechanisms.

One promising new method is Partial Response Maximum Likelihood (PRML). Traditional technology uses a threshold technique to detect a peak from an analog signal: If the signal reaches a point above the threshold, a digital high is recorded. The problem with this method is the difficulty of distinguishing between a valid bit of data and a noise spike. Today's controllers use either retries or ECC (Error Control Circuitry) algorithms to verify the data—which takes time—or else they “window” the data so it is read at a specific interval and not in between.

PRML measures not only the peak of each signal, but up to 16 distinct points on the analog wave leading up to the peak (in the case of a 4-bit implementation)—a technique that has

been used at much slower speeds in modems for some time. By analyzing the level of each point and the rate of change between them, a custom Digital Signal Processor (DSP) can know for certain whether or not it is dealing with a real piece of data. A noise spike, for instance, will rise much quicker than a valid read signal.

Another technology on the horizon is magnetoresistive heads, which vary in resistance as the magnetic field underneath them changes. The amplitude of the signal that a traditional inductive head receives depends on the rotational speed of a drive. Hence 1.4- and 1.8-inch drives, with their smaller circumferences, must rotate faster than the larger ones to produce the same quality signal. With such fast rotational speeds, a slight misalignment in the servo can mean that the head will not read exactly where it wrote, and an error occurs. Drive density is held back by designers to ensure that this does not happen.

Magnetoresistive heads allow for slower rotations and can use separate physical heads for reading and writing. The read head can be tuned for a slightly narrower path than the write head, so the chance of a read error is reduced and density can be increased. With the reduced track width, drive makers may be able to attain densities on the order of 1GB per square inch; current densities are about $\frac{1}{8}$ of that. While magnetoresistive heads are an exciting technology, the high cost of producing the necessary parts has de-

layed their implementation. Only one of the drives reviewed here, the IBM 0662 Model S12, uses a combination of PRML technology and magnetoresistive heads to pack 1.05GB of data onto three platters, as opposed to the seven or eight platters used in the other equivalent drives.

Another emerging technology is the use of “wet” drives. Visqus Corp. pioneered this concept before being acquired by Conner Peripherals, which is currently planning to develop wet-drive products. Wet drives use a cushion of liquid, instead of air, between the platters and the heads. Liquid tends to be less turbulent than air and therefore is better at preventing head crashes. While this technology theoretically offers higher capacity, technical issues have kept it from being cost effective. Finding a liquid that will not corrode the disk and a way to recirculate the liquid in a uniform fashion as centrifugal force splatters it to the edges of the platters are a couple of the hurdles yet to be overcome.

Another idea yet to come to market is glass platter drives. Since a glass surface is denser, smoother, less temperature-sensitive, and more durable than aluminum, it allows disk density to be increased by as much as 50 percent. And because glass platters are rigid and thin, they can be used in situations where shock tolerance is a key issue, like small form-factor drives in notebooks and removable drives. Seagate's 2.5-inch disks are expected to use glass platters. □

heads. The drive uses a variable number of 512-byte sectors per track for storage; its 512K cache has a variable segmented look-ahead buffer. It is rated for 300,000 hours mean time between failures.

The M2694ESA's benchmark test results are also fairly typical for its class: On all our throughput tests, it came in solidly in the middle of the pack.

The company does not sell directly to

end users and relies on the retail seller of the drives to establish warranty terms. On the other hand, Fujitsu provides toll-free technical support, 10:00 A.M. to 8:00 P.M. eastern time, Monday through Friday. There is no company bulletin board system, but there is a fax-back option for technical information.

Despite its high list price, the Fujitsu M2694ESA has a competitive street price

and provides solid performance.

► FACT FILE

Fujitsu M2694ESA

Fujitsu Computer Products of America, 2904 Orchard Pkwy., San Jose, CA 95134; 800-626-4686, 408-432-6333; fax, 408-894-1709.

Estimated selling price: \$1,033 to \$1,400; list price: \$2,130.

Circle 464 on reader service card

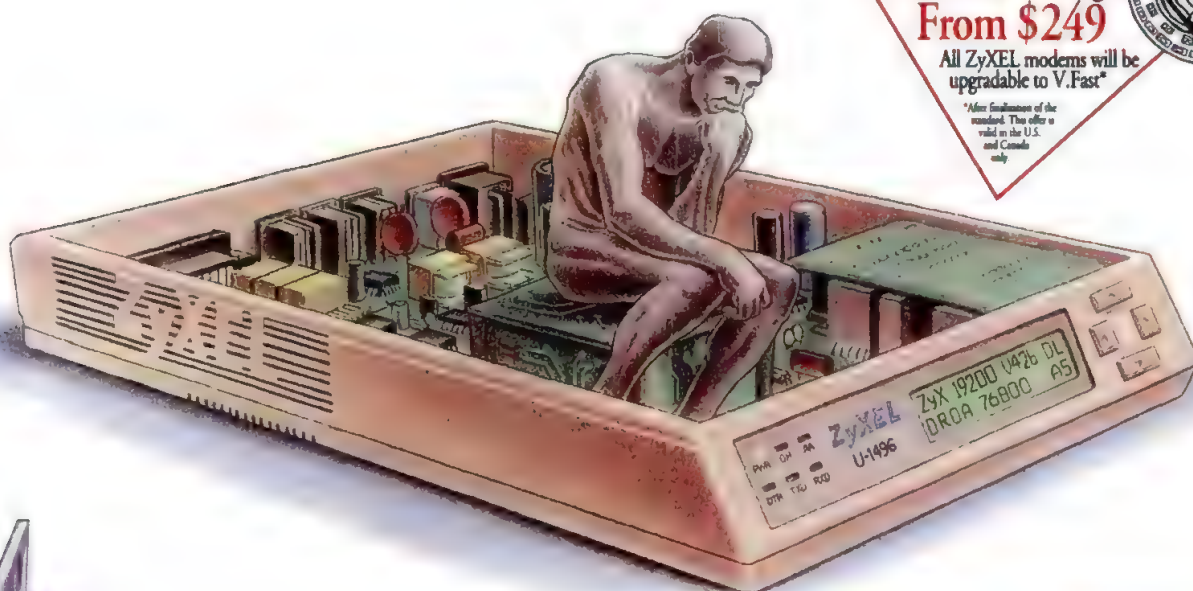
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CIRCLE 927 ON READER SERVICE CARD



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June 28, 1993
ZyXEL U-1496 Plus



February 1993
ZyXEL U-1496 Plus



ZyXEL U-1496E Plus

The future has to start somewhere.

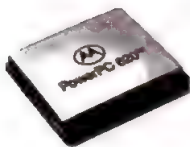
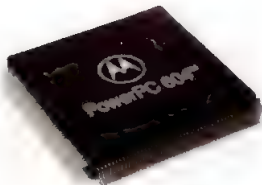
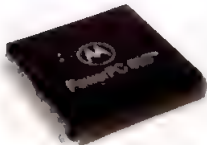
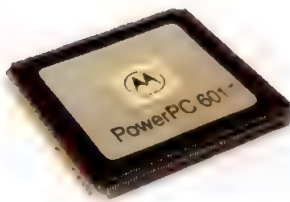
We predict it will start in very close proximity to Motorola's PowerPC™ Microprocessors.

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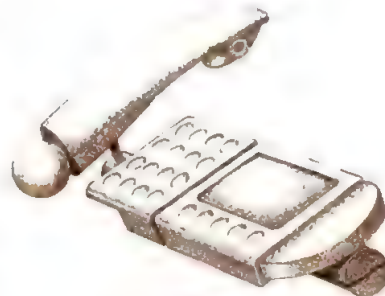
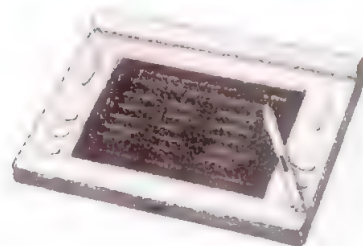
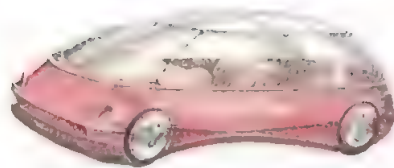
The one thing all those technologies need is extraordinary processing power. Processing power that only PowerPC Microprocessors can deliver.

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CIRCLE 385 ON READER SERVICE CARD

Large Hard Disks

► SUMMARY OF FEATURES

Large Hard Disks

Products listed in alphabetical order

■ = YES □ = NO

	PC MAGAZINE EDITORS' CHOICE				PC MAGAZINE EDITORS' CHOICE	
	Adstar IBM 0662 Model S12	Conner BAJA CP-31370	DEC DSP3160	Fujitsu M2694ESA	HP C2247	Maxtor MXT-1240S
Formatted capacity	1.05GB	1.37GB	1.6GB	1.08GB	1.05GB	1.24GB
Height (inches)	1	1.6	1.6	1.6	1.6	1.6
Spin rate (rpm)	5,400	5,400	5,400	5,400	5,400	6,300
Average seek time (milliseconds)	8.5	10	10	10	10.5	8.5 (read), 9 (write)
Average latency (milliseconds)	5.6	5.5	5.6	5.6	5.6	4.8
Average access time (milliseconds)	14.1	15.5	15.6	15.6	16.1	13.3
Average throughput (megabytes per second)	3.7-4.5	3.5-5.4	2.3-4.5	5.1	2.1-3.7	2.9-10
Burst throughput (megabytes per second)	10	10	10	10	10	10
Number of platters	3	7	8	8	7	8
Maximum power consumption (watts)	10.5	10.3	13.7	13.5	15.6	42
Mean time between failures (hours)	800,000	250,000	300,000	300,000	300,000	300,000
Cache						
Buffer type	Multisegmented look-ahead; read/write	Segmented look-ahead; read/write	Adaptive multisegmented look-ahead; read/write	Variable segmented look-ahead; read only	Segmented look-ahead; read/write	Segmented look-ahead; read/write
Size (kilobytes)	512	256	512	512	256	256
Customer Support						
Telephone numbers for technical support	N/A	800-426-6337, 408-456-4500	N/A	800-626-6112, 408-432-6333	N/A	800-262-9867, 408-432-1700
Hours (eastern time)	N/A	10:00-8:00 M-F	N/A	10:00-8:00 M-F	N/A	8:00-8:00 M-F
BBS/fax-back document service	■ □	■ ■	□ □	□ ■	■ ■	■ ■
Warranty (parts and labor)	5 years	2 years	5 years	Determined by distributor	5 years	3 years

N/A—Not applicable. Technical support for this product is handled by the distributor.

All of the data in this table is based on manufacturers' specifications.

Hewlett-Packard Co.

HP C2247

BY JAMES KARNEY

Available through OEMs, distributors, and VARs, the 1.05GB HP C2247 is available in three SCSI-2 configurations that vary according to data path width and noise reduction: Fast SCSI-2 single-ended, Fast SCSI-2 differential, and Fast-Wide SCSI-2 differential. SCSI-2 differential offers better noise reduction along the bus and thus allows longer cabling, assuming that the host offers that feature. Wide SCSI uses a 16-bit data path, as opposed to the 8-bit path of Fast SCSI. We tested the single-ended Fast SCSI-2.

The HP C2247 has seven platters and uses all but one side of one platter to store data; the remaining side is reserved for servo information. Like most of the other drives reviewed here, the 3.5-inch HP has a 1.6-inch height, a 10.5-ms average seek time, a 5,400 rpm spin rate, and a 256K segmented look-ahead cache. The HP

C2247 drive also offers a synchronous spindle function for use with an advanced RAID system. The number of sectors per track can range from 54 to 96; the mean time between failures is 300,000 hours.

Compared with the other drives, the HP C2247 had average scores on both sets of tests—Sequential Read and Write and Random Read and Write—for the two block sizes. Hewlett-Packard offers a five-year warranty; technical support is handled by the distribution channel.

Hewlett-Packard has been in the disk drive business for more than 20 years. The company offers a range of SCSI, ESDI, and ATA drives with formatted capacities ranging from 234MB to 2.1GB.

All in all, the HP C2247 is a solid unit that offers good performance.

► FACT FILE

HP C2247

Hewlett-Packard Co., P.O. Box 58059, Santa Clara, CA 95051-8059; 800-826-4111.

Estimated selling price: \$1,299; list price: none (product not available to end users).

Circle 465 on reader service card

Maxtor Corp.

Maxtor MXT-1240S

BY ALFRED POOR

The Maxtor MXT-1240S is a 1.24GB drive that lists for \$1,539. Street prices can run to about \$1,500 or even as low as \$1,179, which puts the drive slightly below \$1 per megabyte. On our throughput tests, the MXT-1240S proved itself one of the better performers.

Maxtor offers the MXT-1240S in Fast SCSI-2 single-ended and differential versions. SCSI-2 differential reduces line noise, allowing for longer cabling. We reviewed the single-ended version.

The MXT-1240S has specifications similar to those of other drives we tested, but has slightly faster seek and access times (8.5 ms and 13.2 ms, respectively). This is due in part to the MXT-1240S's high rotational speed: While all the other tested drives spin at 5,400 rpm or slower, the MXT-1240S spins at 6,300 rpm. Despite its higher rotational speed, Maxtor

HARDWARE

Large Hard Disks

► FACT FILE

EDITORS CHOICE Maxtor MXT-1240S
Maxtor Corp., 211 River Oaks Pkwy., San Jose, CA 95134; 800-462-9867, 408-432-1700; fax, 408-432-4510.
 Estimated selling price: \$1,179 to \$1,500; list price: \$1,539.

Circle 466 on reader service card

Quantum Corp.

Quantum ProDrive 1225

BY M. DAVID STONE

The \$1,775 Quantum ProDrive 1225 is available through direct market distributors, VARs, and as original equipment on some computers. Street prices range from \$1,099 to \$1,300 (as low as \$1.05 per megabyte). Quantum offers the Model 1225 in Fast and Wide single-ended and differential SCSI versions. The Model 1225A is an IDE drive with the same capacity. We tested the Fast SCSI single-ended version.

The Quantum 1.05GB Model 1225, a solidly mainstream product, has a 10-ms seek time and a 15.56-ms average access time. The technology is also garden variety for 1GB drives, with 5,400 rpm and a 256K intelligent cache that is shipped as a single segment but can be set for multisegmented operation. Not surprisingly, its performance on our tests was also average compared with the other tested drives. We also had a few installation problems.

The company's current drive offerings consist of 12 models with formatted capacities ranging from 560MB to 3GB. Micropolis backs the drive with a five-year warranty and rates it at 300,000 hours mean time between failures. Micropolis will honor the warranty even if you buy the disk as part of a computer system.

Fifteen unmarked jumper pairs earned the Quantum last place for ease of use. The first drive sent for review was inoperable, and the second required several calls to tech support to get it working. But once set up, the drive performed

well. As we went to press, Micropolis started shipping a new 1.05GB drive, the Model 2210, which the company claims will feature improved performance.

► FACT FILE

Micropolis Model 2112
Micropolis Corp., 21211 Nordhoff St., Chatsworth, CA 91311; 800-395-3748, 818-709-3325.
 Estimated selling price: \$1,099 to \$1,300; list price: \$1,775.

Circle 467 on reader service card

Quantum Corp.

Quantum ProDrive 1225

BY M. DAVID STONE

With a formatted capacity of 1.225GB, the \$1,475 Quantum ProDrive 1225 is Quantum Corp.'s high-end drive. The typical street price for the ProDrive 1225 is \$1,169 to \$1,400, which works out to a very reasonable \$1.05 per megabyte.

The 3.5-inch, 1.6-inch-high drive offers multiple zone recording and comes with a 512K cache that features an adaptive, look-ahead segmented cache buffer. Nonetheless, the comparatively slow 4,500 rpm spin rate translates to a 6.7-ms latency and a slow 16.7-ms access time. On our tests, the ProDrive 1225's performance was about 15 to 20 percent below the others. This fall, Quantum plans to announce a low-profile (1-inch-high) gigabyte drive that it says will incorporate a rotational speed of 5,400 rpm and new, advanced features that improve performance while conserving power.

Quantum sells 21 hard disk models, all 3.5-inch format or smaller, with a 42MB drive anchoring the low end. The company backs the ProDrive 1225 with a five-year warranty when purchased through distributors. If you buy the drive as part of a computer system, the system vendor determines the warranty.

Quantum sells 21 hard disk models, all 3.5-inch format or smaller, with a 42MB drive anchoring the low end. The company backs the ProDrive 1225 with a five-year warranty when purchased through distributors. If you buy the drive as part of a computer system, the system vendor determines the warranty.

► FACT FILE

Quantum ProDrive 1225
Quantum Corp., 500 McCarthy Blvd.,

Micropolis Model 2112	Quantum ProDrive 1225	Seagate ST11200N
1.05GB	1.225GB	1.05GB
16	16	16
5,400	4,500	5,400
10	10	10.5
5.6	6.7	5.6
15.6	16.7	16.1
4	3.7	2.9 5.1
10	10	10
8	7	7
31.6	27	28
300,000	350,000	200,000
User-definable segmented look-ahead; read/write	Adaptive segmented look-ahead; read/write	Adaptive multisegmented look-ahead; read/write
256	512	256
818-709-3325	800-826-8022, 408-434-9262	408-438-8222
10:00-9:00 M-F	10:00-8:00 M-F	11:00-8:00 M-F
■ □	□ □	■ ■
5 years	5 years	5 years

gives the drive a mean time between failures of 300,000 hours. Like many of the other drives we tested for this story, the MXT-1240S has a 256K segmented look-ahead cache.

With its fast rpm rating, the Maxtor drive took first place on the Random Read test for both block sizes, as well as on the Sequential Read test for the 4K block size. On the rest of the tests, the MXT-1240S performed significantly above average.

Along with its high-capacity drives, Maxtor makes a wide range of other storage devices, including tiny 2-inch hard disks for notebook computers.

Maxtor offers toll-free technical support from 8:00 A.M. to 8:00 P.M. eastern time, a 24-hour, seven-day bulletin board, and a fax-back information service. The company backs this drive with a three-year warranty on parts and labor that it will honor even if you buy the drive as part of a computer system.

The Maxtor MXT-1240S stands out from the pack with its excellent price, performance, and support.

With its fast rpm rating, the Maxtor MXT-1240S drive took first place on the Random Read test for both block sizes.



AT 9 A.M. HE DIDN'T KNOW HOW TO WORK WITH A DATABASE.

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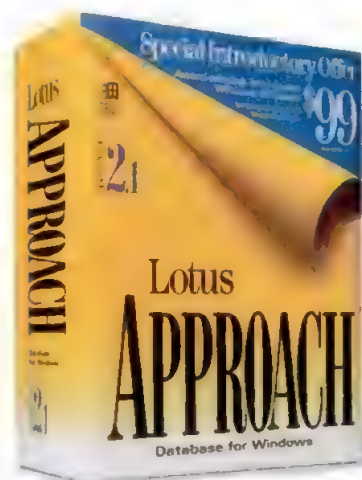
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HARDWARE

Large Hard Disks

Milpitas, CA 95035; 800-624-5545, 408-894-4000.

Estimated selling price: \$1,169 to \$1,400; list price: \$1,475.

Circle 468 on reader service card

Seagate Technology Inc.

Seagate ST11200N

BY M. DAVID STONE

Seagate Technology is one of the most familiar names in hard disks, and its ST11200N drive, with a 1.05GB formatted capacity, provides solid performance.

While Seagate doesn't specify list prices, the ST11200N's street price of \$1,069 to \$1,250 works out to about \$1 per megabyte. The Seagate features a 10.5-ms average seek time and 16.2-ms average access time. On our Read and Write tests for both block sizes, the Seagate drive turned in average throughput results.

The technology behind the ST11200N is similar to that of other

drives reviewed here, with multiple zone recording, seven platters spinning at 5,400 rpm, and a 256K adaptive, multisegmented look-ahead buffer. However, according to Seagate, the

*While Seagate
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company's own SCSI controller on the drive offers true multitasking for simultaneous reads and writes. In theory, this should boost performance in environments such as a NetWare network. In practice, however, it did not give the

Seagate any advantage on our throughput tests.

Besides the ST11200N, Seagate offers many other drives that cover a broad spectrum of choices, with more than 200 models and formatted capacities, ranging in size from 40MB to a whopping 3.2GB. The drives are used as original equipment on many different PCs and are available through VARs, and through virtually any direct-market distributor that handles hard disks.

The ST11200N carries a five-year warranty, which Seagate honors even if you buy the disk as part of a PC system. Solid performance and a generous warranty make this drive well worth considering. □

► FACT FILE

Seagate ST11200N

Seagate Technology Inc., 920 Disc Dr., Scotts Valley, CA 95066; 408-438-8111; fax, 408-438-7852.

Estimated selling price: \$1,069 to \$1,250; list price: none (product not directly available to end users).

Circle 469 on reader service card

On sure, they tell you they've got an accounting system that operates under Windows and has promising new functionality. But before you take the bait, take a closer look.

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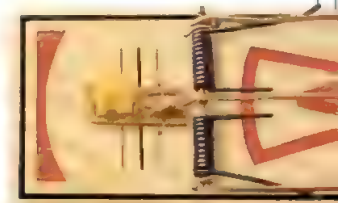
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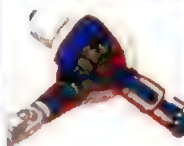
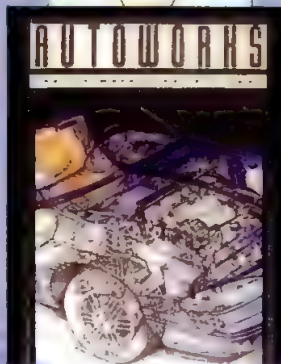
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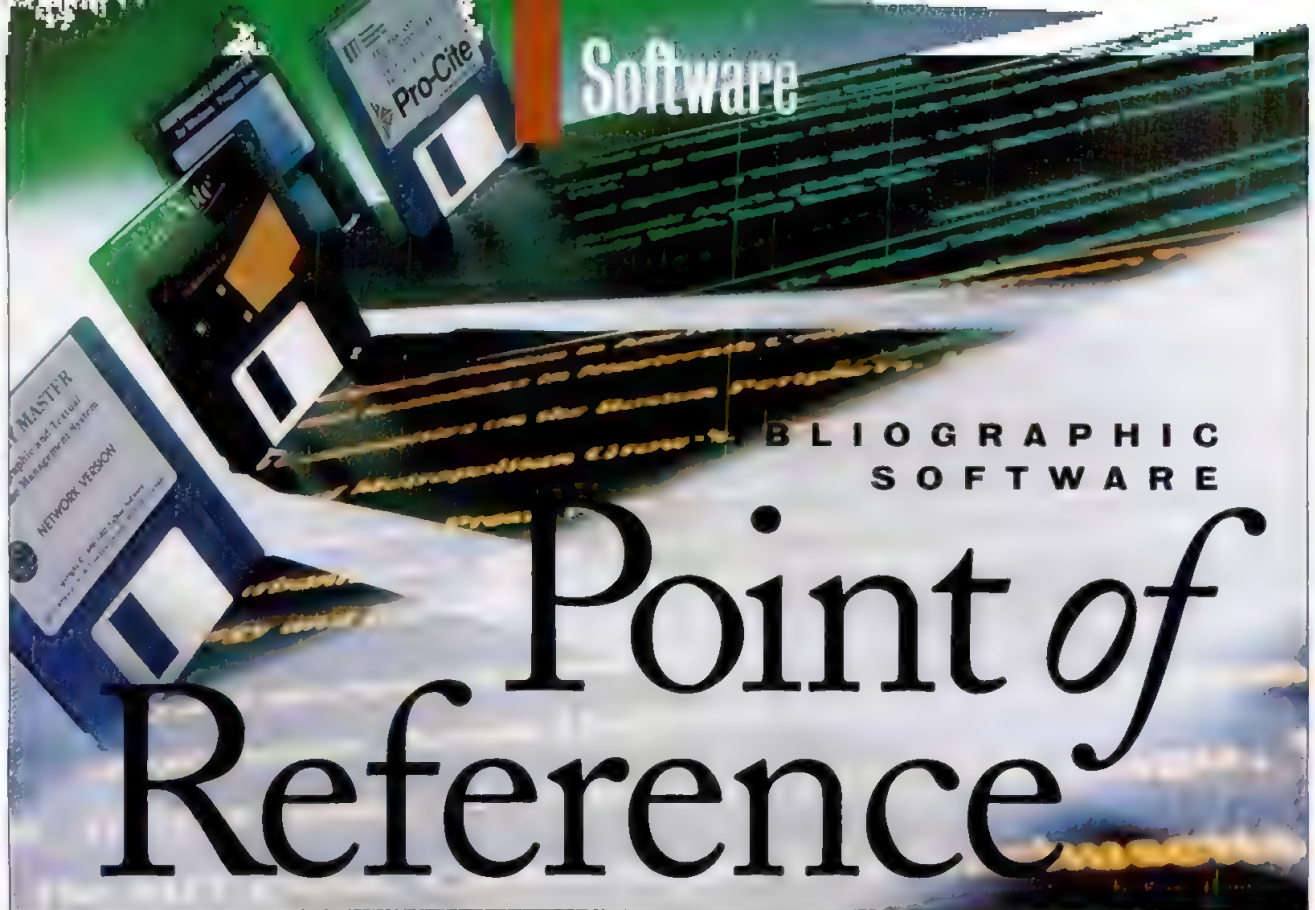
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Term papers and scholarly documents should move out of authors' hands considerably faster with today's bibliographic tools.

by Rubin Rabinovitz

You've stumbled onto a key discovery. You've written it up. A top journal wants your article. Fame and glory await—but first (sigh) you've got to work on the bibliography.

Sigh no more. There are specialized programs that let your computer perform the dull and painstaking chores that can make compiling bibliographies so frustrating. Once you're up to speed, you'll find that cranking out a bibliography can be—if not fun—much less of a drudge.

To be sure, bibliography programs require an upfront investment of time for learning the commands and keying in data. But barring mishaps, you'll never type in a reference twice; you'll be able to keep using it, even if you have to change the punctuation style of your citations.

BEST OF THE BIBLIOGRAPHERS

Bibliography programs are a blend of database and word

processing programs with a number of special features for managing bibliographic data thrown in. For example, if after an article is rejected you want to send it elsewhere, these programs can revise your bibliography so that it conforms to the punctuation style of another journal. Similarly, if you decide to turn a group of essays into a book, you can instruct the program to combine a number of bibliographies and punctuate them in the required new style.

A good bibliography program brings many other paybacks, too. It can save you the trouble of keying in data by downloading citations from on-line sources like MEDLINE (800-638-8480) and Paper-Chase (800-722-2075); from CD-ROM databases like Silver Platter and Compact Cambridge; or from monthly disk update services like Current Contents on Diskette and Reference Update. Even if you don't plan on using on-line sources, you'll find yourself doing progressively less typing

IN THIS REVIEW

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Bibliographic Software

as your database grows larger: Entries such as authors' names, journal titles, and keywords will be saved in alphabetical files that you can copy when you're creating new records.

ONE STEP

More and more bibliography programs are offering global editing. Ordinarily, if a group of records has a recurring error, you need to go through the entire database and correct each one individually. Instead, global editing lets you instruct the program to search the database, find the incorrect items, then emend them, much as you would when using the global search-and-replace routine on your word processor.

The best programs handle a wide variety of the other operations necessary for creating and working with bibliographies, such as deleting duplicate records, generating foreign characters and scientific symbols, sorting according to foreign alphabets, sorting records by any of their fields, revising previously entered data, creating new fields in existing records, using Boolean searches to find information in the database, and importing and exporting data to a word processor.

LOTS TO CHOOSE FROM

There are some 50 bibliography programs on the market, and they range from unadorned shareware products to full-featured packages. It's worth spending a bit more to get one of the better programs, which can handle such difficult challenges as conforming to an unusual bibliographic style or downloading from an obscure on-line database. Bibliographic work involves satisfying many finicky requirements (italics or underlining? first name or initials?). Questions like these may strike you as trivial at first, but once they become *your* problem they start looking like major headaches. Chances are that the developers of a so-

phisticated package will have thought through remedies to such problems before you encounter them.

Still, buying a top-rated package isn't always the best strategy. Files from most bibliography programs aren't readily interchangeable, so it makes sense to find out what other people in your field are using—especially if you will need to share their databases. You might decide it's

worth living with a mediocre program if doing so will save you the trouble of keying in hundreds of references.

Another important consideration is word processor support. Of course you'll want a program that works with your word processor. But that's not enough. Your bibliog-

raphy program should also support some other popular word processing packages, given that some editors insist on submissions in their own word processing formats. (This, by the way, is one reason that we're not recommending programs designed for only one word processor, like WP Citation for WordPerfect or Ibid for Nota Bene.)

Printer support is important but not crucial. While you will often find it convenient to print directly from your bibliography program, if your printer isn't supported you'll always be able to direct data files to a compatible word processor.

If you plan to download citations from an on-line data service or a CD-ROM database, you'll need to check whether the program you are considering offers an appropriate linking module—and that it works (on-line services sometimes change their downloading formats). It also helps if a bibliography program ships with the punctuation styles required by the journals in your field, although most programs will let you set up new punctuation styles as you need them.

These packages are all good at performing essential bibliographic operations as well as solving many of the odd

problems that crop up when you're creating a bibliography. They can generate the characters needed for Western European languages as well as the scientific symbols included in the IBM character set. They support at least two popular word processing formats and work with ASCII files. They can also download material from on-line and CD-ROM databases, although some programs charge extra for the modules that add this feature.

These are all first-rate programs, but none are without minor flaws. Given the number of accepted standards for bibliographic formats in different disciplines, perfection is still a long way off. Even so, these packages are crammed with features that bring smiles instead of sighs when you're preparing a bibliography.

Niles & Associates Inc.

EndNote Plus

ALL REVIEWS BY RUBIN RABINOVITZ

Originally developed for the Macintosh, EndNote Plus for DOS, Version 1.1, is designed for scholars who write up their own research, as opposed to those—like librarians and archivists—who need to manage large databases.

EndNote Plus is easy to learn and has an attractive interface. Its automatic formatting feature can move references into your word processor, which saves a lot of typing. While working in your word processor, you can insert citation markers in your article that correspond to references in the bibliography program. Afterward, EndNote creates a copy of your paper, substitutes full citations for the markers, and formats a bibliography in the punctuation style you choose.

The automatic formatting feature is available for files created in the following text formats: WordPerfect 4 and 5 for DOS, WordPerfect for Windows, Microsoft Word for Windows, RTF (Rich Text Format), and ASCII. You cannot, however, use EndNote's automatic feature to format bibliographies containing more than about 300 average-length references. This number is adequate for papers but marginal for books, especially those with annotated bibliographies. Still, it is possible to get around this limit

Our Contributor: RUBIN RABINOVITZ is a professor of English at the University of Colorado, Boulder, and a frequent contributor to *PC Magazine*.

EDITORS' CHOICE

• No One Leader

In one important sense, none of the five programs we review here deserves to be named Editor's Choice because no single product towers over the rest. Each is a sound program with truly unique strengths and merits special recognition. On the other hand, each

has unique weaknesses. Also, most of these programs cater to specific market segments, which tends to narrow their appeal. Some programs are now trying to be all things to all people, but they have a way to go before achieving this.

EndNote Plus, for example, offers a particularly good interface. Its automatic formatting feature, which can move references into your word processor, makes working with compatible word processing packages a snap—as long as your bibliographies are relatively short. On the down side, EndNote buyers must pay an extra charge for linkage to on-line databases. Also, the product supports a relatively small number of journal formats.

Library Master is reasonably priced, easy to use, and is especially suited to working with large book collections. It can handle citations for artwork, interviews, and video recordings, and it comes in a network version. You can preview formatted entries, and global editing is promised in the next release.

Papyrus is certainly the value leader of the group, and it has a nice watchdog feature that prevents data-entry errors. Also, it can use the Windows Clipboard. However, global editing is not as comprehensive as it should be, and it doesn't offer full network support.

Pro-Cite was an early leader in the field, so there are lots of Pro-Cite bibliographies out there. It is especially

good for working with large book collections and has a wide array of bibliographic formats.

Individuals, however, may find the package overpriced; moreover, its link modules cost extra. And although Pro-Cite can run in a Windows DOS box, it works poorly with the Clipboard and lacks mouse support.

Reference Manager, the only package available in a Windows version, has some nice ease-of-use touches—like the feature that finds keywords in annotations and automatically enters them into the keyword field. The package also offers a great number of medical journal formats—an asset to scientists but not needed by those who don't work in the scientific community.

In the final analysis, choosing the best bibliographic software means choosing the package that best meets your special needs. Specific advantages (such as being able to use existing databases instead of having to create new ones; a program that works with your word processor) may outweigh the advantages of what, all things being equal, might be judged the "best."

by carrying out the standard formatting procedure in two steps.

NO END IN SIGHT

An EndNote Plus database can hold up to 32,000 records, with 32,000 characters per record. Sorting can be done for up to 16,000 references, and the same number of references can be checked for duplicates. The program supports Boolean searches of its databases and also offers QuickFind, a high-speed search routine.

EndNote comes with nine predefined styles that conform to such punctuation formats as those defined by the American Psychological Association and the Modern Language Association of America. It can import data from the Pro-Cite bibliography program (also reviewed here) as well as from Refer and BibIX, the Unix databases.

Like the other packages in this review, EndNote lets you copy material from one record to another by field—a feature that

saves time when, for example, you must enter a series of references from a single issue of a journal. At present EndNote does not support global editing, though the company plans to incorporate it in a future release.

While the Windows version of EndNote is still to be released (it will be out

in December), the DOS version is about as close as you can get to Windows while still working in DOS. The program offers pull-down menus, superimposed windows, mouse support, an icon, use of the Windows Clipboard, and smooth operation in a Windows DOS box.



Although it's a DOS-based program, EndNote Plus uses a Windows-like screen for displaying different types of data.

ENDLINKS ET AL

At \$249, EndNote Plus is not the most expensive bibliography maker around, but its base price doesn't include EndLink, a module designed for working with data from on-line databases and CD-ROMs. If you plan to download citations, you'll have to spend another \$99 for EndLink, which enables you to access such sources as DIALOG, BRS Colleague, Silver Platter, Knowledge Finder, and databases that use the MEDLINE format.

Bibliographic Software

Because EndNote Plus doesn't print directly from its files, you will need to download your bibliographies to a word processor. The program has a few other minor shortcomings (these, refreshingly, are listed in the manual, so you'll know early on what to expect). For example, you won't be able to change "ed." to "eds." when a book has more than one editor, and you can't give the title first when listing an anonymous work. In general, however, EndNote Plus is a program that is both workmanlike and easy to work with.

► FACT FILE

EndNote Plus for DOS, Version 1.1
Niles & Associates Inc., 2000 Hearst St.,
Berkeley, CA 94709; 800-554-3049, 510-
649-8176; fax, 510-649-8179.

List price: \$249.

Requires: 512K RAM, 1MB hard disk
space, DOS 2.0 or later.

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Balboa Software

Library Master

Library Master for DOS, Version 2.02, is versatile: It comes with 24 templates that let you enter citations for artwork, interviews, and video recordings as well as for books and journals.

The program offers 15 bibliography styles: Along with the more common ones, it supports such formats as those prescribed by the Linguistic Society of America and the American Anthropological Association. Library Master lets you customize any of these styles by changing fields in the program's data in-

put forms—a feature that some of the other programs lack.

As its name suggests, Library Master works efficiently with large databases such as those found in libraries. It can handle 65,000 records, each with up to 65,000 characters; and your database can include up to 50 different record styles. Another advantage for libraries and large organizations is that Library Master also comes in a network version. Unlike the bibliography programs that permit only multiple users to view a database, Library Master also lets network users create and edit records. The integrity of the entries is protected by first-come, first-served record locking.

YES, MASTER

Information in Library Master's database is easily retrieved: You can browse through it by record number, author's name, title of work, or keyword. The data-input template for books has a field for the original date of publication, which may be a minor detail, but one that is missing in many other programs. Library Master even has a preview window that lets you see what a record will look like when you have formatted it in a specific bibliographic style.

Library Master's commands are logical and easy to learn. The documentation—a 148-page introductory booklet and a 427-page manual—is clear. The program comes with a PIF and icon, so Windows users can easily run it in a DOS box; a full Windows version of the package is promised for next year.

Library Master can import data from Pro-Cite and EndNote, as well as from some other bibliographic and database programs. It also supports an excellent selection of word processors, including Microsoft Word and WordPerfect for both DOS and Windows,

XyWrite, Nota Bene, PC-Write, and ChiWriter; it also works with ASCII and RTF documents. Library Master makes an especially good choice for WordStar users because the program supports WordStar cursor-diamond commands.

Library Master can perform searches using the Boolean operators AND, OR, and NOT, as well as *greater than* and *less than*. It gives you three choices for generating foreign letters: using an international keyboard, entering ALT and the ASCII number or, more ingeniously, by combin-

ing characters. Thus, for example, a quotation mark, Ctrl-Backspace, and the letter *o* yield *o umlaut*—very handy if you've forgotten that its ASCII number is 148.

Another welcome extra is the program's ability to do "soundex" searches: If you don't know the exact spelling of an item like an author's name, you can search for it by using a phonetic entry; this feature also helps when you are dealing with British spellings (*theater* vs. *theatre*).

The program can send data directly to your printer, even to an HP LaserJet or PostScript printer. Library Master lacks global editing, but this feature has been promised for the next release.

Library Master costs \$249.95—a very reasonable price when you consider that the basic package includes an import utility that lets you work with data from more than 20 on-line and CD-ROM databases.

Library Master is also an easy program to like: It offers a logical structure, clean operation, flexibility, and many other valuable extras.

► FACT FILE

Library Master for DOS, Version 2.02
Balboa Software, Box 3145, Station D,
North York, Ontario, Canada M2R 3G5;
416-730-8980; fax, 416-730-9715.

List price: \$249.95.

Requires: 384K RAM, 2MB hard disk
space, DOS 2.0 or later.

Circle 442 on reader service card



Library Master's data-entry form has spaces for entering information; a menu bar at the bottom lists commands.



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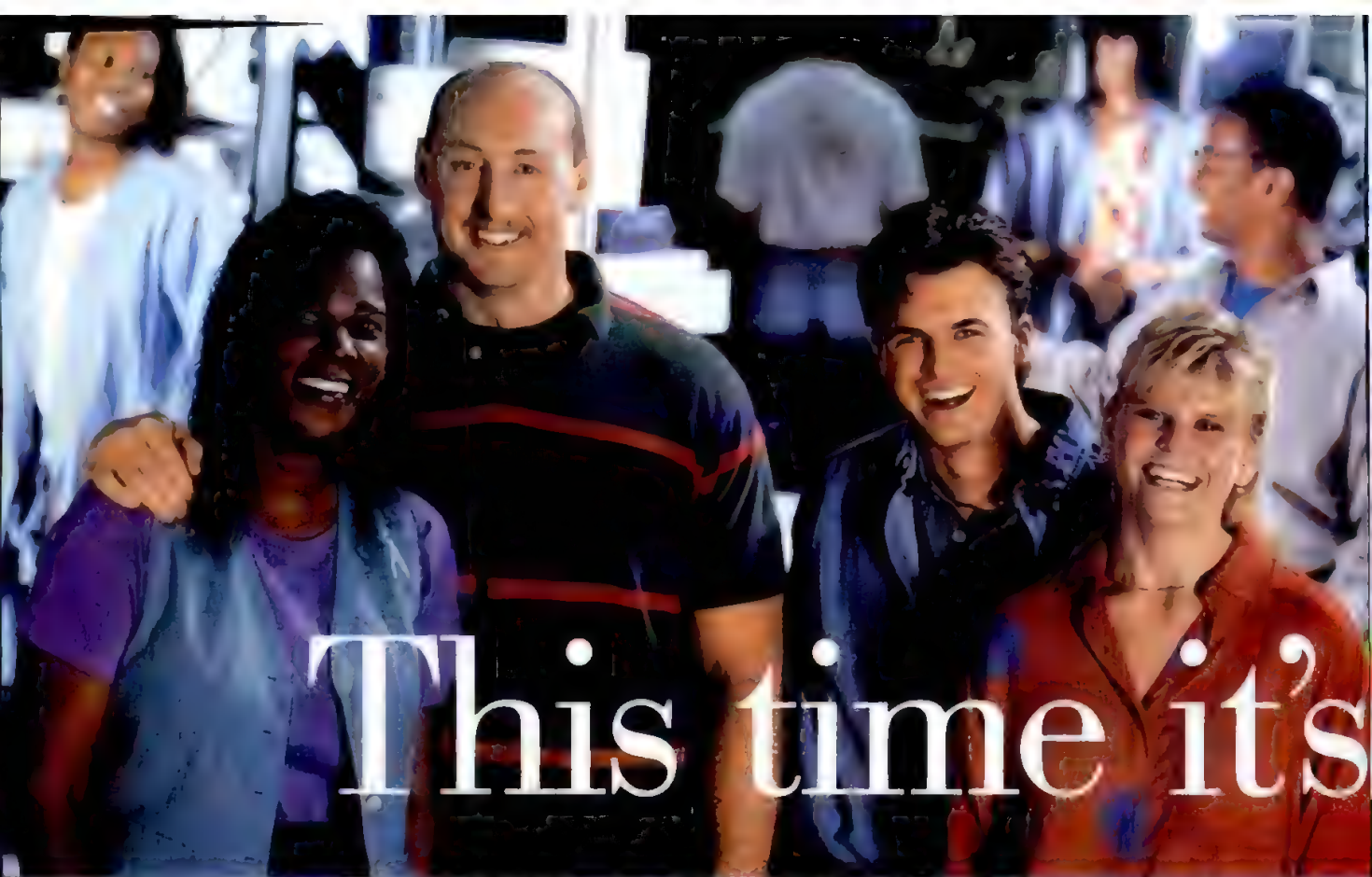
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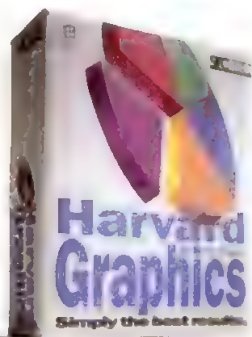
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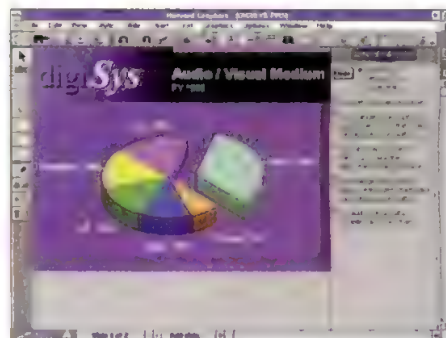
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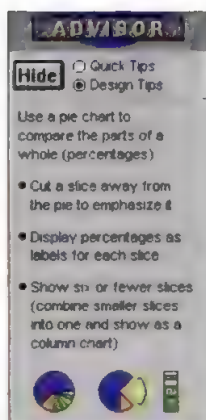
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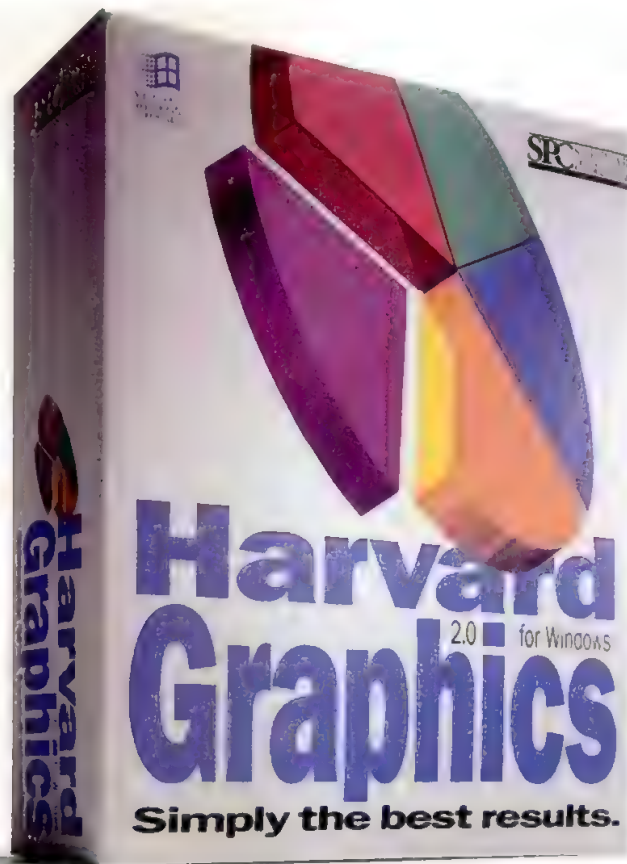
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Bibliographic Software

index is skimpy. Generating Greek letters is easy, but the only option for other foreign-language characters is to enter an Alt-ASCII combination.

Word processor compatibility is very good. The Windows release works with DOS and Windows versions of Microsoft Word and WordPerfect as well as with Ami Pro, WordStar for DOS, XyWrite, and ASCII text editors.

There are a number of helpful features. If you open the Journal Formats window and click on the punctuation style for a particular journal, you'll see a sample reference formatted according to that style. A browse feature shows whether an item you're about to key in is already in the database; if it is, you can copy it. You can perform global editing in four fields: author, editor, journal, and keyword.

An innovative routine saves you the effort of copying keywords into the data-entry template: When you add an annotation to a reference, the program scans it,

seeking previously defined keywords. If it finds any, it automatically pastes them into the keyword field.

Reference Manager's \$499 price includes Capture, a module for working with on-line databases; Splicer, a module for transferring references to an article in your word processor; and more than 100 journal formats. If you don't require

these options, you can get a stripped-down version of the program at a lower cost (DOS: \$99, Windows: \$149. The latter still includes the Splicer).

Reference Manager's main strengths are its large selection of journal formats, well-designed convenience features, and (particularly in the Windows version) intuitive operation. It is a good choice if you're doing biomedical research—and the only reasonable one if you're giving a course on glucocerebrosidase. □

► FACT FILE

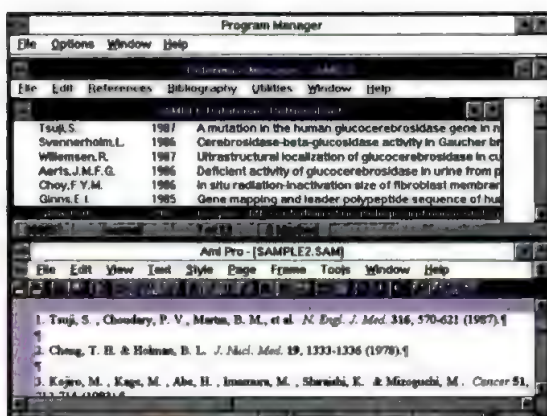
Reference Manager for DOS, Version 5.06

Reference Manager, Professional Edition for Windows, Version 5.5
Research Information Systems Inc., 2355 Camino Vida Roble, Carlsbad CA 92009; 800-722-1227; 619-438-5526.

List price: \$499.

Requires: DOS version: 384K RAM, 1MB hard disk space, DOS 2.1 or later. Windows version: 2MB RAM (4MB recommended), 2MB hard disk space, Windows 3.1 or later.

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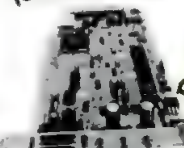


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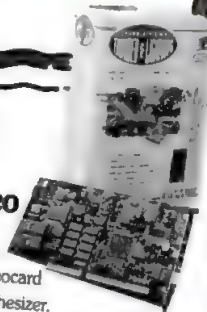
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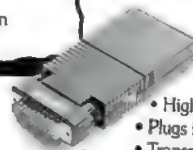
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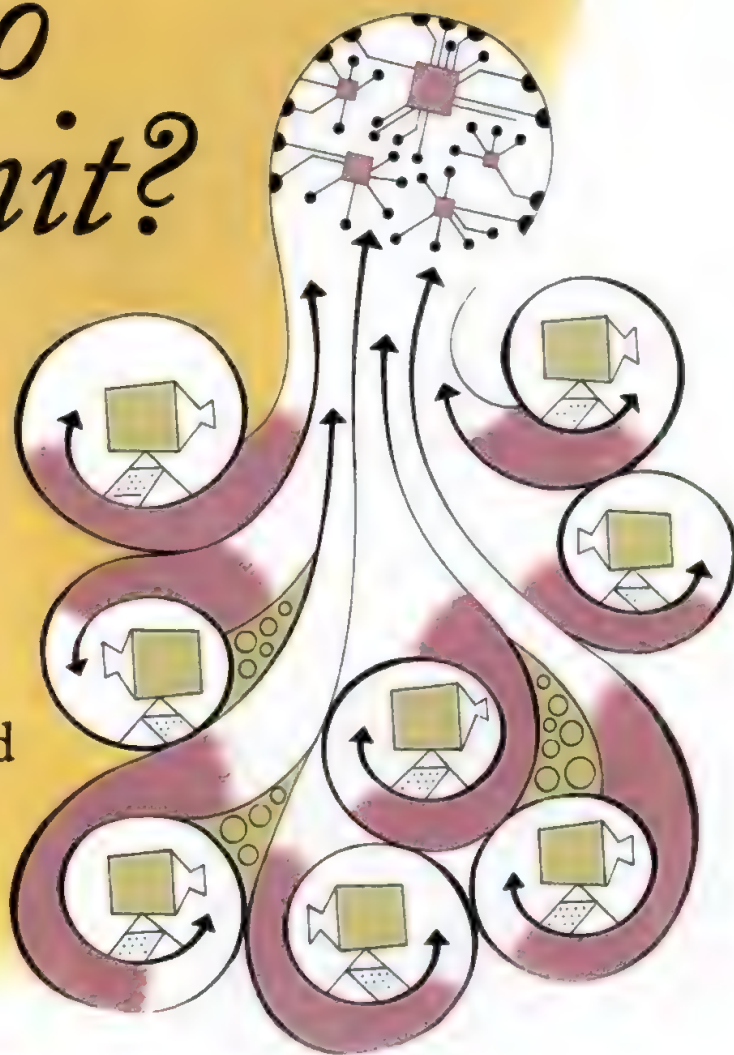
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PC-Based SQL: *Time to Commit?*

When you bank
your business
on a SQL database,
there's no room
for error.
Now more than
ever before, PC-based
servers measure up
to the task.



by Brian Butler and Sheryl Canter

Client/server SQL (Structured Query Language) databases have been available on Intel-based systems for years. Yet only now is interest in them exploding. Why?

The low costs of CPU power, hard disk storage, and memory make the move to PC-based servers all but inevitable. At last, it pays to displace mini- and mainframe computers from their traditional turf: large, mission-critical databases. New 32-bit operating systems such as Microsoft Windows NT, NetWare, and OS/2 also offer safety, performance, and

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EDITORS' CHOICE

• Oracle7 for NetWare

comparative ease of use on the PC server platform. Even the new, handsome graphical tools at the client end make SQL queries less of a chore. Still, the big question remains: Is PC-based SQL robust enough to bank your business on?

To find out, we torture-tested seven SQL database servers using a 1-gigabyte, four-table database with a million rows per table—a database some ten times as large as the one we used in last year's SQL roundup (for more information, see "SQL Databases: High-Powered, High Priced," September 15, 1992).

What we found was that most of the seven reviewed products choked on our tests to some extent. Only Oracle7 for NetWare and Sybase SQL Server for NetWare, Version 4.2, survived without need of a midcourse patch. Gupta SQLBase Server for NetWare, Version 5.12—which the company claims is meant to handle smaller databases—took an unthinkable 60 hours to load the tables, and then crashed on the index builds; the company subsequently withdrew the product from the performance test portion of the review. Ingres Server for OS/2, Version 6.4, could not complete the multi-user portion of the test, because of a bug that caused clients to drop from the server. Locking problems with Informix

Client/server SQL databases are among the most complex products available for the PC. The best products have powerful engines that can access data quickly, ensure referential integrity, enforce business rules, communicate with servers on other platforms, and launch

nondatabase applications. Most importantly, these sophisticated features must be implemented flawlessly; SQL databases must be stable and absolutely reliable.

Oracle7 for NetWare meets all these requirements. Completing our performance tests in just three days and without a single hitch, Oracle7 was also one of the best-performing products we test-

OnLine for NetWare, Version 4.1, caused the server to crash repeatedly—sometimes with data loss forcing us to restore from tape.

It is important to note that performance testing can bring out problems that might not surface in a normal production environment. Ultimately, after some tuning and tweaking, all of the products except for SQLBase and Ingres Server managed to complete the full test suite.

Our conclusion? Stable, industrial-strength SQL on the PC is a reality—

though at times an elusive one. Only a careful product selection saves you from installation nightmares, unstable operation, or undue limitations on your growth and migration path.

PRODUCTS FOR ALL PLATFORMS

This year marks the first time that all the reviewed SQL databases are 32-bit implementations, and platforms for reviewed products span DOS, NetWare, and OS/2—the predominant Intel-based platforms. With a couple of notable exceptions, all of

HIGHLIGHTS

Client/Server Databases

PC-BASED SQL databases are now robust enough to handle your mission-critical, enterprise-wide data—but choose carefully. Performance, stability, maximum database size, installation, and administration issues should be on your list of things to check as you investigate the offerings from each vendor.

32-BIT is the big news this year with all seven reviewed products now boasting a 32-bit architecture. One result: For the first time, OS/2 databases can keep up with NetWare Loadable Modules. There are now 32-bit SQL databases for all the popular Intel-platform operating systems:

DOS, OS/2, Windows, and soon Windows NT.

PRICE AND PERFORMANCE are also important considerations. Prices for these products vary widely, from downright cheap to prohibitively expensive. But, performance-wise, you get what you pay for. While a small department may do well with a slow-but-stable engine, a large enterprise should look for speed and capacity found only at the top of the line.

OUR TORTURE TESTS brought five of the seven reviewed products to their knees to one extent or another, showing that stability is still a concern under

some operating circumstances. Only Oracle7 and Sybase SQL Server made it through the test suite without midcourse tweaking or patches.

ORACLE7 was the hands-down winner on our performance tests, outperforming the others by a wide margin. In fact, it finished the entire test suite in less time than most took just to load and index our data. Sybase SQL Server proved an admirable second-best.

BUT WHAT GOOD is a powerful back end if users can't intuitively access the data? In our issue of November 9, we'll look at the GUI development tools used to create SQL database apps.

ed; only Sybase SQL Server for NetWare, Version 4.2, posed a serious challenge. In addition, Oracle7 offers the full gamut of features, including triggers, stored procedures, cost-based optimization, group-level security, declarative referential integrity, and event alerters. Distributed database support is also strong, with two-phase commit and a cost-based distributed optimizer. Oracle7 also offers good cross-platform support. Oracle7's price is high, but you can't do better for enterprise-wide, mission-critical databases.

An honorable mention goes to Sybase SQL Server for NetWare.

the major client/server back-end vendors are represented in this roundup: Gupta Corp., IBM Corp., Informix Software, Ingres Corp., Microsoft Corp., Oracle Corp., Sybase, and Watcom International Corp. Unfortunately, we were unable to review XDB Systems' 32-bit SQL database for OS/2, because the company could not spare the resources needed to participate. Novell has not updated its database server product, NetWare SQL, since we reviewed it last year, so we have not revisited it here. Also, Raima Corp. was slated to ship its new Raima Database Server product line (with versions available for Microsoft Windows NT, NetWare, and OS/2) in this year's third quarter, too late for inclusion in this roundup.

Though both Microsoft and Oracle currently have NT ports of their SQL databases (with Gupta, Informix, and Watcom following close behind), these were not to be released until NT itself was released (see the sidebar "SQL on NT: Exploiting the Strengths"). Version 3.1 of Watcom SQL, Network Server Edition, was the only DOS product we reviewed. It is available in three versions: 16-bit DOS, 32-bit DOS, and Windows. The DOS versions are available as standalone or network enabled; the Windows product is standalone only. We reviewed the 32-bit networked product for this story.

Gupta's SQLBase is available for DOS, OS/2, and NetWare; the company submitted the NLM version for review. NLMs

Though pricey for installations with 13 to 28 clients and not as strong as Oracle7 in terms of distributed database support, Sybase SQL Server is stable, feature-rich, and fast. And like Oracle7, Sybase SQL Server managed to get through our performance tests with nary a hitch.

Watcom SQL, Network Server Edition, a new entrant to the PC-based SQL database market, also deserves an honorable mention. Version 3.1 is not particularly fast, but it's solid as a rock—a slow but steady performer suitable for small to medium-size applications. Watcom SQL is also the cheapest option by far. In absolute dollars, it's about a tenth the

(NetWare Loadable Modules) are generally much faster than DOS or OS/2 products, because they run at Ring 0, essentially becoming part of the operating system. One school of thought says that NLMs are potential time bombs because the operating system is not protected from the NLM; if the NLM crashes, the server will crash. We, however, did not find NLMs to be inherently less stable than OS/2 or DOS products.

THE MOST STABLE OF THE CLIENT/ SERVER SQL DATABASES THAT WE TESTED WERE ORACLE7, SYBASE SQL SERVER, AND WATCOM SQL.

Last year, the 32-bit NetWare products were much faster than the OS/2 products, which were all still 16-bit OS/2 1.x applications. This year's all-32-bit lineup levels the playing field, showing that a well-written OS/2 SQL server can compete with an NLM. In informal testing, Microsoft SQL Server for NT, Version 4.2, and Oracle7 for NT also demonstrated that NT products can deliver competi-

price of the competition, and it is also the cheapest in terms of cost per transaction. With easy installation and few tunables, Watcom SQL is an especially good choice for those new to client/server databases.

Gupta SQLBase Server for NetWare (Version 5.12), Informix OnLine for NetWare (Version 4.1), and Ingres Server for OS/2 (Version 6.4) all boast rich feature sets but were not fully stable during performance testing. IBM DB2/2, Version 1, was very stable, but its IBM-shop orientation and the requirement that the entire database fit on one physical disk is too constricting for us to recommend it at present.

tive performance.

IBM released OS/2 2.1 during our testing of SQL databases, so we started off with OS/2 2.0 on the server and ended up with OS/2 2.1. We had endless problems with OS/2 2.0 because of incompatibilities with the Compaq machines used in our test-bed. An IBM service pack solved some of the problems but introduced others. These difficulties, however, all disappeared with OS/2 2.1. If you've had stability problems with OS/2 in the past, we recommend upgrading to the new version.

Performance testing was conducted at PC Magazine Labs with extensive vendor participation. We gave vendors a testing specification and provided the code to implement the spec. Vendor representatives then spent a minimum of two weeks with us in the lab while we performed the performance tests.

BIG MUSCLES, BIG CRASHES

Client/server SQL databases are built to handle the kinds of huge databases and multiuser loads that have been the tradi-

Our Contributors: BRIAN BUTLER, who directed testing for this story, is president of Client/Server Solutions, a firm specializing in application development and database performance testing. SHERYL CANTER is a software developer and frequent contributor to *PC Magazine*. RICHARD FINKELSTEIN is president of Performance Computing, a consulting firm specializing in client/server development. THOMAS MACE was the associate editor in charge of this story, and JAY MUNRO was the project leader.

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Suitability to Task:

Client/Server Databases

We speak of client/server SQL databases as a single category, but not every back end is suited to every type of application. Some back ends were designed to handle all your company's mission-critical data, while others are better for more mundane but still vital chores.

For **enterprise-wide applications**, a SQL database must have a large capacity, support distributed databases and multiple networking protocols, and be able to connect to minis and mainframes through gateways or the DRDA. The best products include cost-based distributed optimizers and two-phase commit. Support for the TCP/IP networking protocol is important for connecting to Unix systems. Stored procedures, which improve speed and can be used to ensure enterprise-wide compliance with business policies, are also important here.

The requirements for smaller **departmental applications** are very different from those for enterprise-wide apps. Here, the general accessibility of the product overrides considerations of performance and capacity. In judging suitability in this category, we look for a low price, general ease of installation and use, few tunables, and high-quality documentation that includes tutorials and an overview of how the product's pieces work together.

In **decision-support applications**, the key factors are the ability to load data quickly, perform ad hoc queries, and generate reports. The best products

SUITABILITY TO TASK				
Product Name	POOR	FAIR	GOOD	EXCELLENT
Enterprise-wide apps	●	○	○	○
Departmental apps	●	●	○	○
Decision-support apps	●	●	●	○
Mission-critical apps	●	●	●	●
Transaction processing	●	●	●	●

also have broad front-end support and provide engine-level features such as forward- and backward-scrollable cursors to improve flexibility and response time.

SQL databases used for **mission-critical applications** must first and foremost be bug-free and stable. Once this minimal requirement is met, we look for fault tolerance, on-line backup, flexible restore options, engine-supported auditing, and good security features. Security provisions should include a large set of granular privileges and the ability to set security options by group as well as by individual user.

When SQL databases are used for **transaction processing**, they must have flexible isolation levels that let the database administrator optimize for concurrency versus consistency. The best products also have event alerters that signal critical database changes, use triggers to implement business rules, and have engine-enforced referential integrity either through triggers or SQL syntax. The ability to launch nondatabase applications when defined database events occur is also a plus here.

tional province of mainframes, minicomputers, and multiprocessor Unix servers. File/server database management systems such as Microsoft FoxPro and Borland's Paradox, which bring the data over the network to the client for processing, are simply not efficient enough to handle tasks on this scale. Client/server technology lets the database front-end off-load SQL processing to the back-end server. Only the result sets travel back to the client, greatly reducing network traffic.

Since large client/server databases are generally the lifeblood of businesses that use them, SQL database servers provide a myriad of complex features to ensure database integrity and minimal downtime. Ironically, the very complex-

ity of these features can make SQL databases vulnerable to showstopping bugs that crash the server. The most stable products we tested were Oracle7, Sybase SQL Server, and Watcom SQL (a new entrant into the SQL database market). The new IBM DB2/2, Version 1, was stable once we got it up and running, but hardware and software compatibility problems made this exercise far from trivial. Other products raised a variety of stability concerns.

Though any client/server database has a larger capacity than a file/server system does, the category is far from homogeneous. SQL databases vary greatly in both price and performance. Some products, such as Watcom SQL

and DB2/2, are relatively inexpensive and easy to administer, but slow performers. Others, such as Oracle7 and Sybase SQL Server, are feature-packed, highly tunable, and blazingly fast—but cost top dollar. The choice of which product best suits your needs depends on whether you are using it for a departmental database—SQLBase's forté—or an enterprise-wide application. (For an analysis of the price/performance trade-off, see the sidebar "Getting What You Pay For".)

SQL databases that are geared toward enterprise-wide applications also include support for distributed databases and cross-platform communication. Oracle7, Ingres Server, and Sybase SQL Server lead the pack in this area. Oracle7 and Ingres Server are the only products that support transparent two-phase commit needed for synchronization in a distributed environment. Sybase SQL Server offers an API (application programming interface) for programming it manually.

The next release of Sybase SQL Server—System 10—will place even greater emphasis on distributed processing, but in the form of replication rather than a distributed database model. Replication is a more loosely synchronized form of distributed processing. Instead of copying entire tables or databases, the scheme is transaction-based: Clients register with a replication server for only the information they'd like to receive. One big advantage is that the replication server can store the requested information and resend it later if the link with the client is temporarily broken. In a distributed database, if the client were offline, the transaction could not be completed. The looser synchronization of replication is adequate for most applications, but some will still require the tight coordination of distributed databases (see the sidebar "Distributed vs. Replicated Databases").

TOP SECURITY

For mission-critical databases, data integrity is paramount. SQL databases provide for this in a number of ways. All support what is called *transaction processing*: Changes to the database are not written to disk until a COMMIT command is issued. If you change your mind

Just about every SQL database management system we looked at choked to some extent on our performance tests. Ingres Server for OS/2 failed to complete the multi-user tests, and Gupta withdrew its SQLBase Server for NetWare from the tests entirely. Oracle7 for NetWare was the standout performer across the board; Sybase SQL Server for NetWare performed admirably as well. Informix OnLine for NetWare's scores were respectable, while those of IBM DB2/2 and Watcom SQL were mixed.

How We Tested

To evaluate the SQL databases in this roundup, PC Magazine Labs chose a subset of tests from the AS3AP (ANSI SQL Standard Scalable and Portable) Benchmark Tests for Relational Database Systems, developed at Cornell University by Carolyn Turbyfill, Dina Bitton, and Cyril Orji. AS3AP is a cross-platform battery of benchmark tests covering a spectrum of typical database operations.

We used a 486/50 Compaq Systempro/XL as our database server, equipped with 64MB of RAM and 2.2GB of hard disk storage (eight Conner hard disks), two Madge Smart 16/4 EISA Ringnode Token-Ring cards, and a Compaq IDA-2 SCSI controller card. On the client side, we used 36 identically equipped 386SX/16-based Compaq Deskpro 386/N computers equipped with Proteon ProNET-4/16 P1390 Token-Ring cards. For the Ad Hoc Query and Mixed Workload tests, we used an additional Compaq Deskpro 486/33M client equipped with a Madge Straight Blue 16/4 Token-Ring card. We used an additional NetWare file server running on a Compaq Systempro 486/33 equipped with a Madge Smart 16/4 EISA Ringnode Token-Ring card for file services. This server held the data files, client software, and executables used for the performance tests.

We conducted all the tests on a NetWare 3.11 network running SPX/IPX over Token-Ring. Since IBM does not provide NetWare support for DB2/2, the company provided its own network drivers and NetBIOS version. Also, since IBM DB2/2's drivers cannot span a database over multiple hard disks, we had to change the IBM configuration to give the product more contiguous storage.

Our test database consisted of four tables, each comprised of 1 million rows. Each row was approximately 160 bytes long (the exact values varied by vendor). Test data for each table was supplied in the form of an ASCII comma-delimited file. The value types in the database columns included integer, floating-point, and date, as well as fixed-length and variable-length character strings.

We are not presenting the results for Gupta SQLBase Server for NetWare; its Load and Index time was so slow that the company had to withdraw from our performance tests in the early stages for lack of available lab time. Later, PC Labs invited Gupta back, providing ample time to perform the data load. SQLBase successfully completed loading after 60 hours—almost twice as long as it took the next-

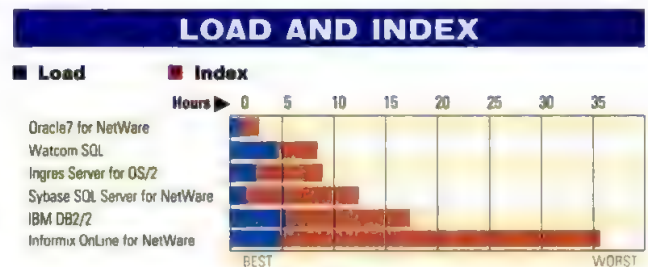
slowest competitor. SQLBase then consistently crashed each time we tried to create the indexes required to perform the test, sometimes destroying the database in the process. The company then withdrew from testing entirely.

Ingres Server for OS/2 was unable to complete the multi-user tests (Random Read, Random Write, and Mixed Workload) because of a bug in the DOS client software, causing clients to drop the server connection spontaneously. It completed the remaining tests successfully.

LOAD AND INDEX

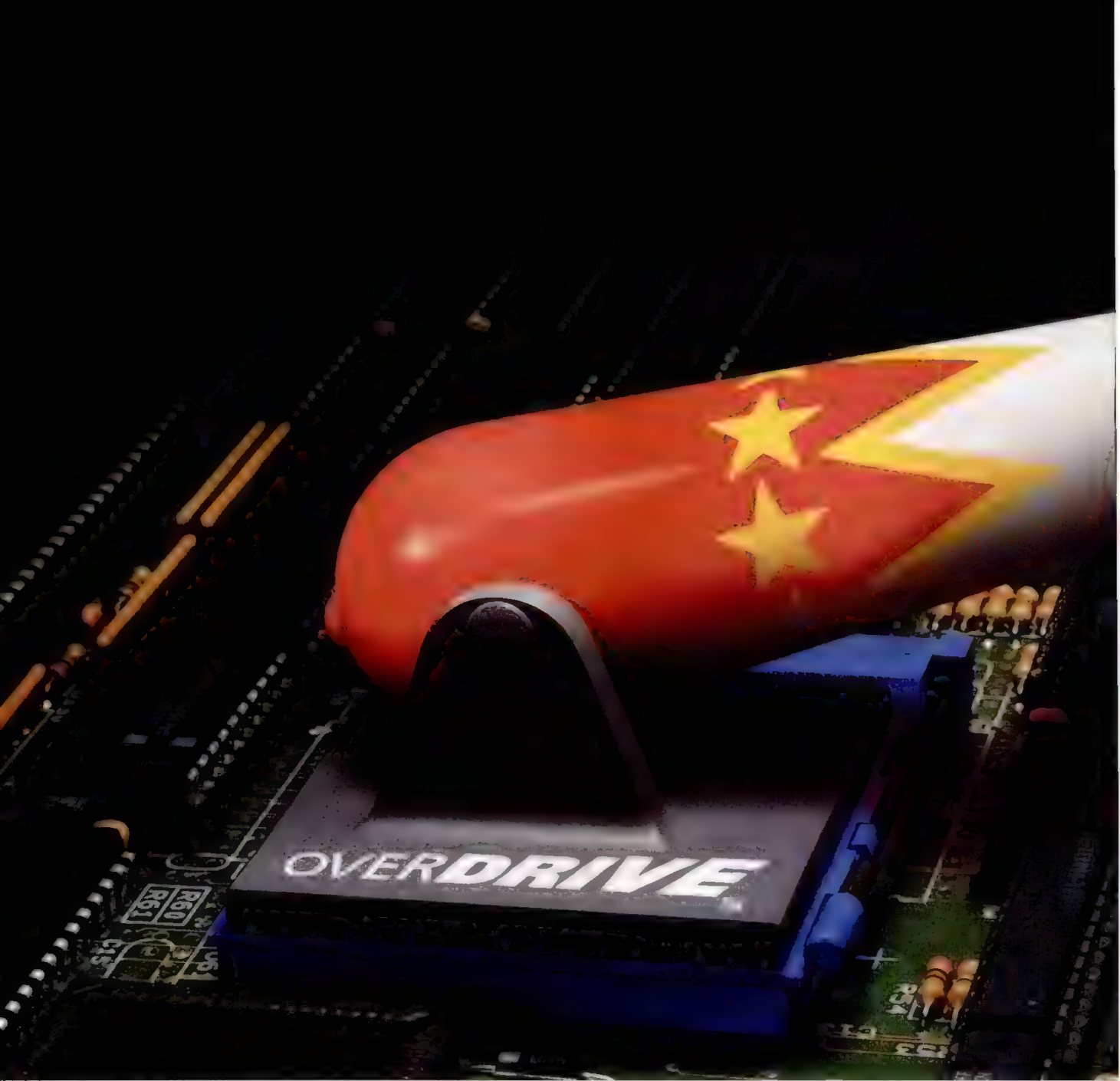
The Load and Index test measures how quickly the database system can import our 4-million-row tables and create 12 standard indexes and 4 clustered primary indexes. Vendors that did not support clustered indexing used straight B-tree indexes. Only three vendors support clustered indexes: Informix, Ingres, and Sybase.

Most vendors supported a method for loading the data from the server, thus eliminating network bottlenecks and optimizing load rates. The only exceptions were the products from Gupta and Informix. For these two, the import files were placed on a separate NetWare file server. The 486/33 client was then used to read the files and import them into the database server across the LAN. Since network latency and throughput are a bottleneck in this sce-



nario, neither one of these products performed well relative to the competition. Both required a custom C application to import the data.

Oracle7 for NetWare was the top performer overall, using its NLM-based SQL*Loader utility to load the tables. SQL*Loader loads data in a variety of formats, performs filtering (selectively loading records based on data values), and can load multiple tables simultaneously. In fact, SQL*Loader is so complex and powerful that the manual devotes about a



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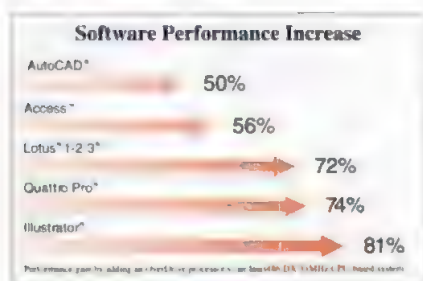
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hundred pages to describing it. SQL*Loader also uses a data-loading language that is upward-compatible with IBM's DB2 Load Utility.

SQL*Loader's Direct Path option contributed to Oracle7's fast loading time. With this option, the ASCII files are directly formatted into database blocks (Oracle's term for database pages) and written directly to the database, bypassing most RDBMS processing. Oracle7's load time was only 13 percent faster than Sybase SQL Server for NetWare's, but it was three to four times as fast as the rest of the competition. Oracle7 created the standard indexes almost twice as quickly as the nearest contender, Watcom SQL, and almost nine times as fast as IBM DB2/2.

Surprisingly, Watcom SQL came in second overall; its table load time was fourth and its index time second. For performance reasons, Watcom decided to write a custom C application to load the data, instead of using its SQL extension. Watcom SQL's B-tree indexing helped keep the index time down but exacted a significant penalty on our Ad Hoc Query test.

Ingres Server's load, index, and combined times were all third-place. It imported the data by using the COPY command, an Ingres SQL extension. The COPY command proved very easy to use and let us batch the loading of the data. We first copied data onto the OS/2 server, and then a script executed the loading and indexing of all the tables. This convenient feature let us load the tables overnight. Other products needed processes with at least two steps for loading the tables, and also required user intervention.

Sybase SQL Server placed second in terms of its table load time but fourth overall and for indexing. Sybase now bundles an NLM version of its Bulk Copy Program (BCP), which greatly improved its table load performance. Sybase SQL Server supports clustered indexes and thus paid a penalty in index creation while netting a performance gain on the

other tests. To create a clustered index, the database physically rearranges all the rows in key order. But if you remove the clustered index time from consideration, Sybase SQL Server slips from fourth to fifth place.

IBM DB2/2 placed fifth overall but came in last in terms of its load time. IBM does provide a utility to load comma-delimited files, but these files must be in a special format. We also used a third-party fast loader available for IBM DB2/2, which ultimately delivered scores that rank with the NLM-based loaders, but it took several tries before IBM could supply us with a working version of the program.

RANDOM READ

The Random Read test shows the maximum number of concurrent retrievals the system can handle. For this test, each workstation randomly selects a single row from the same table, which is then fetched across the network; results are then discarded at the client by directing the output to the device NULL. We did not display the results, since we did not want the terminal I/O to play a role in the measurements.

Records were read in the lowest lock level that the product would support, thus permitting the greatest amount of concurrency (we required that each

vendor take at least a shared-level lock on the row or page level). Since the all locks are shared-level, no blocking occurs. Multiple clients can access the same row or page without concurrency loss.

We ran each client level for 10 minutes. Timings for the first 4 minutes are discarded,

giving the system time to fill the cache and reach 2 steady state. We then took the next 5 minutes' worth of timings and discarded the last minute's timings. This method lets us guarantee accurate and consistent scores. The Random Read test lasts for 1 hour 40 minutes. Throughput is calculated in transactions per second (TPS).

Sybase SQL Server clearly outperformed the others on our Random Read test. This is partly due to its NLM architecture and clustered indexing. Oracle7 placed second but was bottlenecked by the hard disk subsystem. Since Oracle7 does not support clustered indexes, it was forced to perform at least one I/O per lookup. At 150 TPS, Oracle7's CPU utilization of the server was a mere 15

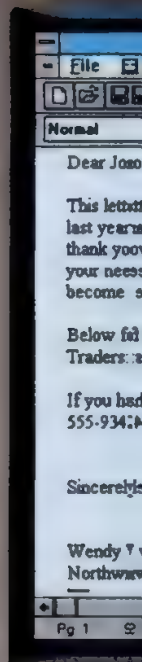


Finally, IBM wrote a custom C program to import our test data.

OnLine came in last overall; its table load time was second to last and its index score last. Since Informix Software provided no utility to load comma-delimited files, the company wrote a custom C application to do the job. Informix couldn't write an NLM version of this load utility on such short notice, however, so the load had to take place from a client, over the LAN. This hurt OnLine's table load time. (The package did do well when creating standard indexes, however.) In creating the clustered indexes, its performance was poor. Informix will fix this problem with the next release.

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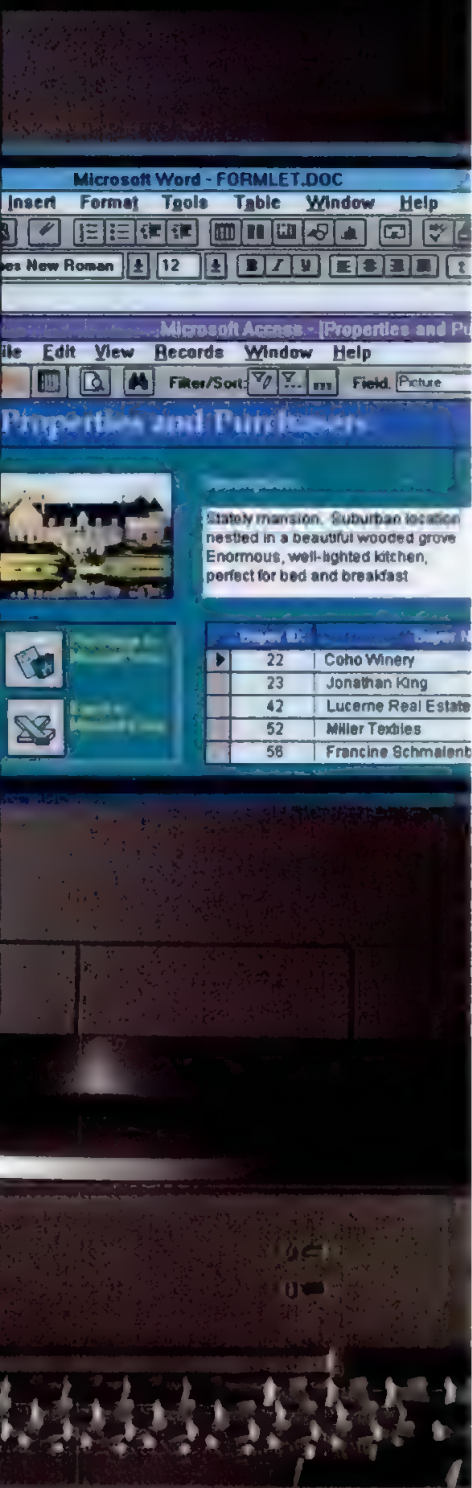
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percent. Sybase SQL Server, on the other hand, obtained a peak throughput of 200 TPS with about 90 percent CPU utilization. We feel that with a faster hard disk subsystem, Oracle7 could have easily broken the 200-TPS mark.

We have numerous problems getting OnLine's control logic to work, but once past these hurdles it performed well. The server bugs we encountered affected simultaneous access to rows and lock time-outs, but we were eventually able to work around the problems. The tested version of OnLine is the first release on the NetWare platform; the company says the next maintenance release will fix these problems.

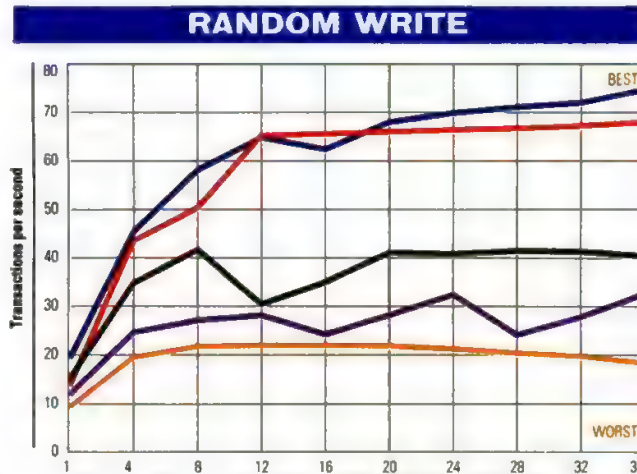
DB2/2 and Watcom SQL did not perform nearly as well as the others. Both products were at a disadvantage because they support only one network card at a time. Watcom SQL was not a top performer on any of our tests, so much of its performance can be ascribed to the inherent limitations of its engine. DB/2 did perform quite well on our other tests, however. One culprit might be IBM's use of NetBIOS, a very slow protocol. Another contributing factor may be the process architecture of DB2/2 itself, with its high context-switching overhead. Ingres Server was unable to perform our multiuser tests, because of the client software bug mentioned earlier.

RANDOM WRITE

The Random Write test shows the maximum number of concurrent updates the system can perform. For this test, each workstation randomly updates a single row from the same table. The test modifies the value of a nonindexed field so that only the row has to be updated. Indexes remain

untouched. Rows are accessed in update mode, which permits data sharing in the table but does not allow anyone else to access the row (or page, depending on the lock granularity) currently being updated.

We ran this test in much the same way we ran the Random Read test, taking timings only during the middle 5



minutes of a 10-minute run at each client level after a steady cache state had been achieved. Again, the total time of the test was 1 hour 40 minutes. We calculate the throughput in server TPS.

The results of the Random Write test clearly demonstrate certain performance benefits of the 32-bit NLM platform. Sybase SQL Server outperformed Oracle7, but we must point out that Sybase's engineers had to change the attribute of one of the table columns from NULLable to NOT NULL. While this seems like a trivial detail, the change caused a three fold improvement in Sybase SQL Server's performance. At the original specification, Sybase produced 25 TPS; in the changed configuration it produced 75 TPS.

Oracle7 achieved a peak throughput of 67 TPS, taking only 10 percent longer to complete the task than Sybase SQL Server did.

Oracle7's strong performance was due to record-level locking, as well as a new

caching feature that allows the clients to share SQL context areas (called Shared SQL Pools).

Oracle7 once again showed unusually low CPU utilization, suggesting that it would respond dramatically to a faster hard disk subsystem. Oracle7's strong numbers were achieved without the use of special options. Oracle chose not to use its somewhat controversial Discrete Transaction feature or hashed indexes, both of which would have provided a performance gain.

OnLine finished third in total throughput, with a score of 41.44 TPS. This product uses record-level locking and was able to perform an update-in-place; it also uses a clustered index. Watcom SQL came in fourth in total throughput, with a TPS rating of 32.38, due in part to its use of record-level locking and multithreaded design. DB2/2 was last because it used the slower NetBIOS protocol and possibly because of context switching.

AD HOC QUERY

The Ad Hoc Query test predicts a product's effectiveness in a decision-support environment. The query mix is submitted from a single Compaq Systempro 486/33 client, and the elapsed time for each query is recorded. The ad hoc mix consists of 20 queries that stress four different aspects of the database server: selection, joins, projects, and aggregates.

The six selection queries measure the speed at which the database can selectively scan a table. The eight join queries show how well the optimizer can pick the fastest access path from the available indexes. The test includes two projection queries to evaluate each database's sort utility,



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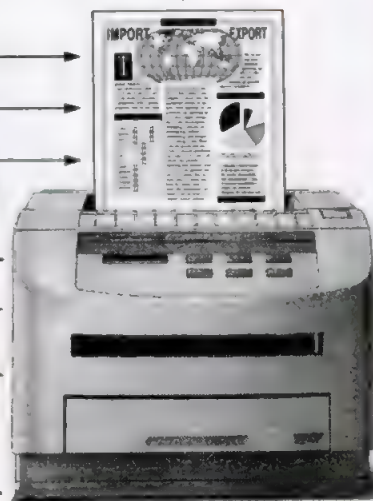
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CIRCLE 304 ON READER SERVICE CARD





as most projections require a sort. The four aggregate queries show how well the products can calculate a variety of aggregates (minimum, maximum, average, and count).

Oracle7 completed the queries in a blistering 47 minutes, three times as fast as most of the other products. Ingres Server, DB2/2, OnLine, and Sybase SQL Server all completed the Ad Hoc Query test within 10 minutes of each other, with times around 2.5 hours; Watcom SQL trailed the pack, with a total elapsed time of over 19 hours. Interestingly, the OS/2 products held their own against the NetWare products, an indication of the power of this year's new 32-bit implementations.

The only tested products lacking read-ahead capabilities are Sybase SQL Server and Watcom SQL. Read-ahead greatly increases the speed at which the database can read data from the hard disk. Instead of reading a page at a time from the disk, the database can read groups of pages. The exact number is usually a tunable database parameter. Oracle7's speed is attributable to its read-ahead abilities, fast sorting, and new query optimizer.

OnLine, on the other hand, has one of the least advanced optimizers—one that uses only limited statistics to determine the access path. In looking at OnLine's results closely, we found that a single query accounted for more than an hour of its total score.

This illustrates that an optimizer that chooses the wrong access path for a query can be an extremely expensive liability. Watcom has a rule-based optimizer with no read-ahead capabilities. Thus, if the optimizer made a mistake (which it often did), its slower I/O speed caused the query to run for hours.

MIXED WORKLOAD

The Mixed Workload tests show the effect of concurrency on a cross-section of transactions executed on one workstation. There are three tests in the Mixed Workload suite: No Interference, Concurrent Random Reads, and Concurrent Random Writes. Mixed-workload transactions were submitted with repeatable-read isolation levels. The random-read and random-write transactions ran in the same isolation level.

For the No Interference test, a workstation runs a mixed workload of 12 database operations, including queries, updates, and an aggregate report joining

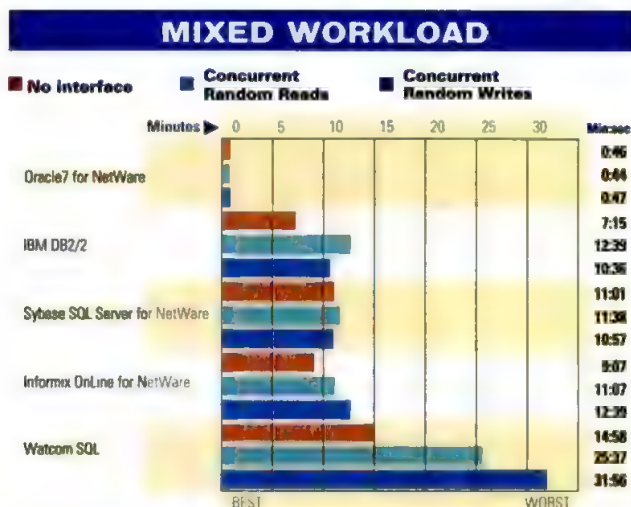
test is the same as the Concurrent Random Read test, except that we run random-write operations on the 36 clients rather than random-read queries. The workstations running both the Concurrent Random Read and Concurrent Random Write tests access just one of the two tables that the Mixed Workload station accessed.

The Mixed Workload results were almost identical to the Ad Hoc Query results. The only difference was that Ingres Server edged out Oracle7 on the No Interference test. As Ingres Server could not complete the full Mixed Workload suite because of the DOS client software bug, no performance numbers are presented.

Sybase SQL Server's Concurrent Random Write scores were faster than its Concurrent Read scores due to lock escalation. During the Random Write tests, a lot of exclusive locks were taken on the table, with the result that the pages locks were escalated to a table-level lock. This allowed the program to complete the query more quickly and thus remove locks faster. The downside is that Sybase SQL Server experienced a drastic dip in the TPS rating of the clients, from 7.2 TPS to under 1 TPS; Watcom SQL was the only other product to experience a similar dip, to 4.9 TPS (these results are not shown).

Oracle7's read-consistent model and record-level locking helped it breeze through the test. Its query times remained basically unchanged, even with a load. (Oracle7's database model does not use blocking. If a transaction sees that a page has been modified, the engine gets the image of the row from the row-back segment.)

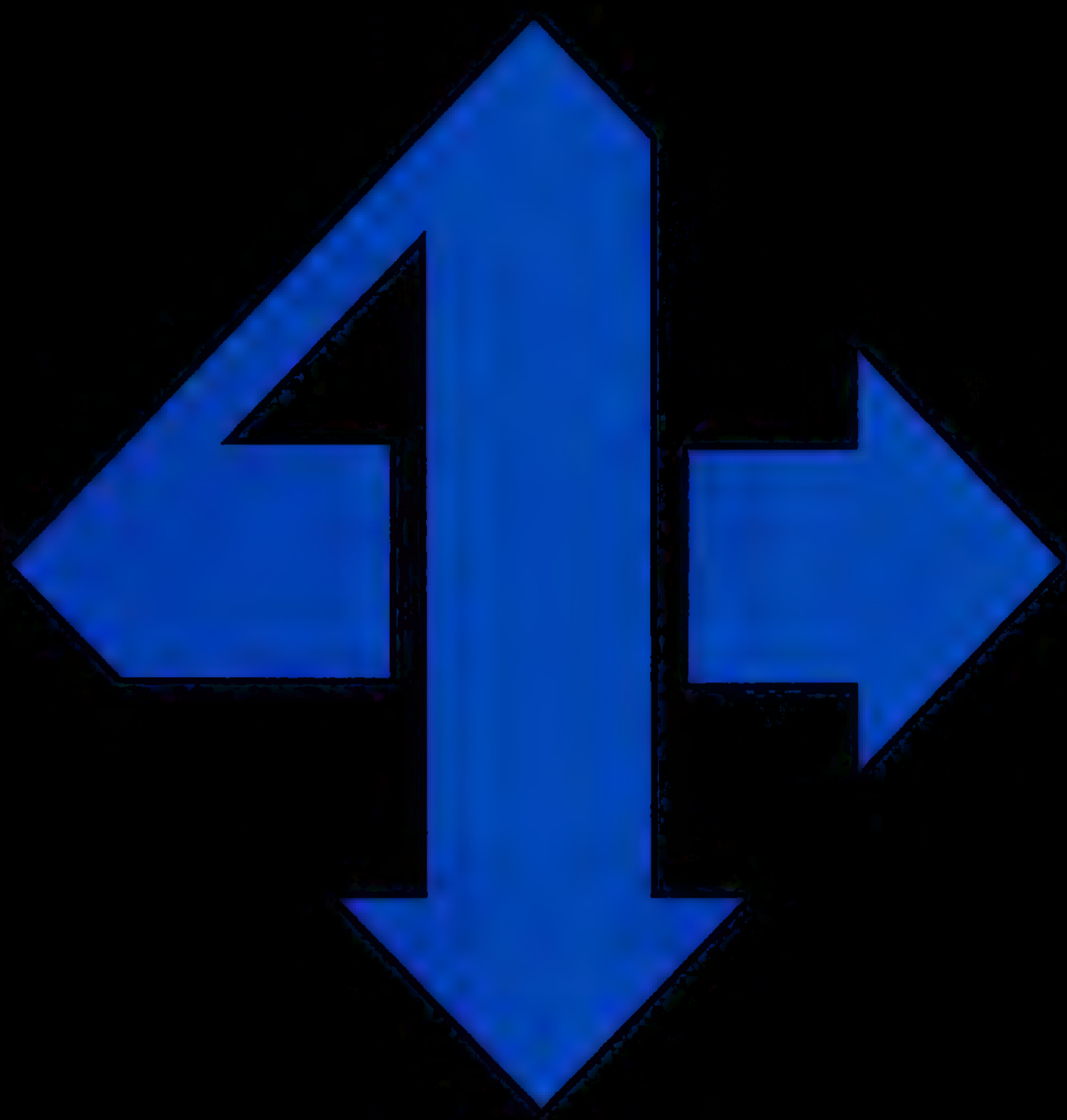
DB2/2's concurrent random writes were a little faster than its concurrent random reads. While it has record-level locking, the locking of the mixed workload blocked some of the workstations from doing updates. The TPS rating for its concurrent random writes was lower because of contention. This in turn put less of a load on the server, allowing the queries to complete faster. OnLine and Watcom SQL also use record-level locking.



two tables. We record the time to run all 12 operations. This provides a baseline against which to compare the effect of concurrency on the workstation.

For the Concurrent Random Reads test, we run the Random Read queries on 36 clients but add a think time to force the overall TPS rating seen at the server to 7.2 TPS. We let the 36 workstations execute for 3 minutes to bring the database cache to a stable state before we add a thirty-seventh workstation running the same Mixed Workload routines used in the No Interference test. When the thirty-seventh test is finished, we stop all stations and record the TPS rating of the clients. This rating lets us see how the locks generated by the Mixed Workload suite affect the clients submitting the random-read queries.

The Concurrent Random Write



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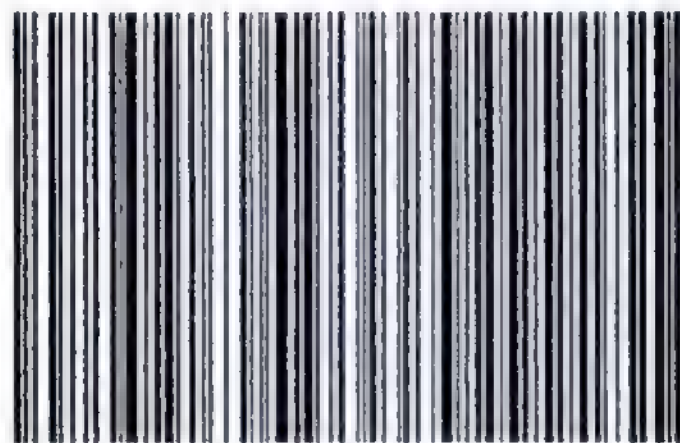
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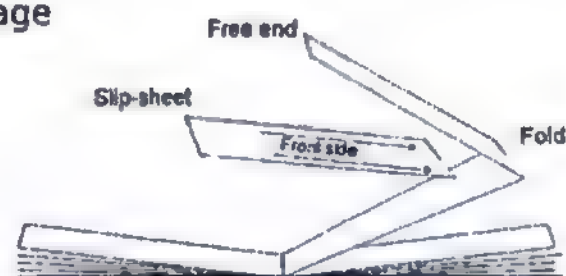


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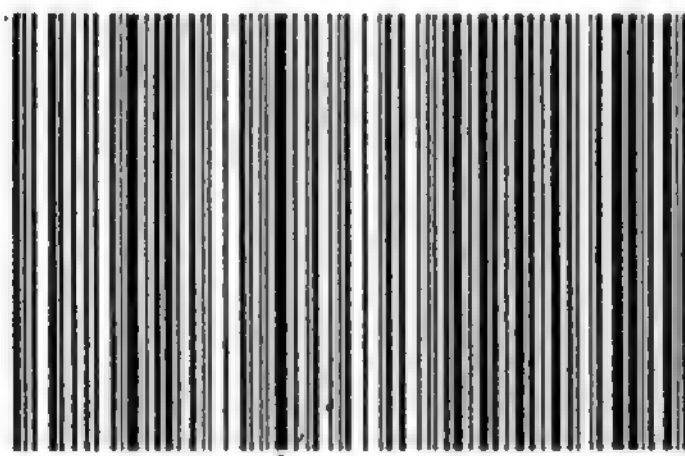
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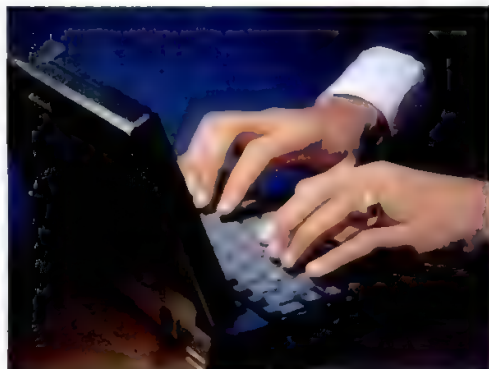
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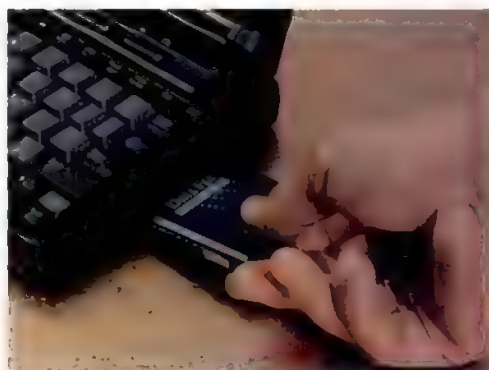
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about the change, or if the database crashes midstream, a ROLLBACK command can be issued, returning the database to a pretransaction state. This is an important feature for data integrity, because sometimes transactions are only valid in batches—for example, in a banking application where one account is debited and another credited. If both transactions cannot be performed, transaction processing gives you the option of performing neither of them.

SQL databases store changes to the database in a transaction log. The most common use of the transaction log is to restore the database in case of a system crash. The latest backup is restored from tape, and then the changes in the transaction log are reapplied to bring the database up to date. Transaction logs can also be used for auditing purposes—keeping track of who does what to the database when. Some SQL databases such as OnLine, Oracle7, and Sybase SQL Server also support an additional fault-tolerance feature called *mirroring*, which writes data to two locations, typically two physically separate disks. If one data set becomes corrupted for any reason, the system can switch over to the mirrored copy instantly.

Triggers, procedures that are automatically executed when certain SQL operations are performed, are another important integrity feature. To understand triggers, it's important to remember the relational nature of SQL databases and the joined-table scheme they use to minimize data storage space. Often, tables are joined in a one-to-many relationship, where one parent record (for example, a customer record) is joined to many child records (for example, order records). The tables are joined by a key, a column such as Customer Number, that exists in both tables. A database maintains what is called *referential integrity* (RI) by ensuring that there are no orphans: child records with no associated parent records.

There are endless debates on how to implement referential integrity in databases. Triggers are used by Sybase SQL

Server and Ingres Server to enforce RI.

The ANSI SQL standard calls for a different means of enforcing RI through an enhanced SQL syntax that supports "primary" and "foreign" keys. This method, termed "declarative referential integrity," is easier to set up, administer, and analyze, and is supported by DB2/2, Oracle7, SQLBase, and Watcom SQL. OnLine supports neither triggers nor declarative

MOST SQL DATABASES ARE HIGHLY TUNABLE, ALLOWING DBAs TO TWEAK EVERYTHING FROM CACHE SIZE TO THE NUMBER OF THREADS ALLOCATED.

referential integrity; it's the responsibility of the front-end developer to write code that enforces RI.

Because mission-critical applications often contain sensitive data, auditing and security are also important issues. Oracle7 and Ingres Server have built-in auditing capability. Sybase SQL Server doesn't have built-in auditing, but auditing is easily programmed using triggers.

FAST RETRIEVAL

Because SQL databases are often used to store huge, enterprise-wide databases, the time it takes to retrieve data is crucial. SQL databases always include some sort of optimizer to determine the best access route. The first optimizers were syntax-based (also called rule-based) and rewrote queries based on syntactic rules governing the fastest access path. Then Ingres developed a technology called cost-based optimization, which uses information about the data stored in the tables to aid in determining the optimal access path. The I/O "cost" of each access path is estimated, and then the "cheapest" path is chosen.

All the products we reviewed except Watcom SQL now support cost-based optimization. An incremental point release of Watcom SQL, which will be available by the time you read this, will incorporate a cost-based optimizer. Most cost-based optimizers utilize only table-level statistics, such as the number of rows, the number of columns, and the minimum and maximum values within a column. Ingres Server and Sybase SQL

Server have gone a step further and store histograms of the data itself.

Stored procedures, which reduce network traffic and eliminate compile time, are another feature that speeds up database access. Stored procedures are compiled SQL, 4GL (fourth-generation language), or 3GL code that is stored on the server and loaded into memory when the database is started.

All the SQL databases we looked at except for Watcom SQL and OnLine support some type of stored procedures. Ingres Server, Oracle7, and Sybase SQL Server can all store compiled 4GL code on the server. DB2/2 can store compiled 3GL code such as COBOL or C in the form of DLLs (dynamic link libraries). SQLBase cannot store procedures with branching logic, but it can store individual SQL statements that can be chained together.

TUNING TOOLS

Most SQL databases are highly tunable, allowing database administrators to tweak everything from the cache size to the number of threads allocated. The trick is knowing what to tweak, and to determine this a performance monitor is handy. Only Oracle7 and OnLine include database monitoring tools. Oracle7's monitor has a unique "what if" capability that estimates how the system will respond to hardware changes such as additional memory. Third-party tools are available for all products lacking built-in monitors, however. Sybase SQL Server provides some performance information via a pair of stored procedures that are bundled with the product. Microsoft SQL Server for NT has an especially impressive performance monitor that provides graphical views of disk I/O, cache hits, and many other tunable parameters.

Client/server SQL databases are a complex but increasingly important part of the PC landscape, and the purchase of a SQL database involves a huge commitment in time and money. Right-sizing is a big investment that can actually pay for itself in a relatively short time—but only if the right SQL database product is chosen. The following set of reviews and performance analyses can help you make the right choice.

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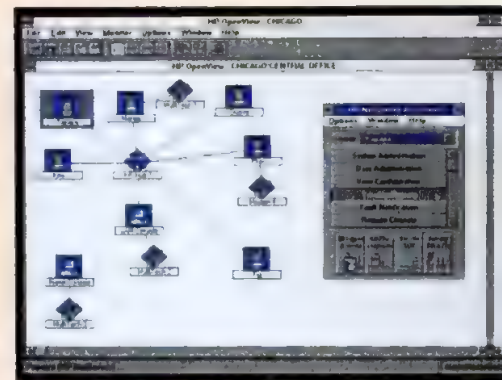
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Open architecture facilitates adding specialized third-party or HP management utilities.

*U.S. list price for HP NetServer LM Model 530, including 486 33MHz processor, 16 MB RAM and 545 MB SCSI hard drive. **U.S. list price for HP NetServer LE Model 340, including 486 33MHz processor, 4 MB RAM and 440 MB IDE hard drive. Prices subject to change without notice. Pentium and the Intel Inside logo are U.S. trademarks of Intel Corporation. ©1993 Hewlett-Packard Company. PPG686

HP NetServer LE



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Gupta Corp.

Gupta SQLBase Server for NetWare

ALL REVIEWS BY SHERYL

CANTER AND BRIAN BUTLER

Gupta SQLBase Server for NetWare, designed for PCs from the ground up, was the first client/server database on the Intel platform and is one of the least expensive products in this roundup. There have been

only maintenance releases (up to Version 5.12) since we reviewed SQLBase last year, but with our revamped tests, we learned new things about the product.

Last year, SQLBase sailed through our performance tests, outperforming most of its competitors. This year, the product showed itself unable to manage the much larger database we used for testing. After repeated crashes during index builds, SQLBase was withdrawn from our tests entirely.

Clearly, SQLBase is not the right choice for large, enterprise-wide databas-

es. At the same time, it can be a good solution for small- to medium-size applications. With its single-user versions for DOS, Windows, and OS/2, SQLBase is well-suited as a development platform, especially if your organization is committed to IBM's SAA (System Application Architecture). Also, Gupta Corp.'s IBM-compatible SQL PreCompiler lets you write COBOL applications that can be used with DB2. Gupta plans to release 32-bit versions of SQLBase for Microsoft Windows NT, NetWare 4.0, OS/2 2.1, and Univel's UnixWare by the end of this year.

■ SQL on NT: *Exploiting the Strengths*

by Sheryl Canter and Brian Butler

The long wait for Microsoft Windows NT is over, and hot on its heels several SQL database vendors are readying ports of their products for the NT platform. Gupta's SQLBase for NT, Informix OnLine for NT, Microsoft SQL Server for NT, and Oracle7 for NT will all be released by the end of this year. Informix OnLine will be the first. OnLine for NT, a port of Informix's Version 5 Unix product, was actually ready before NT itself.

Oracle Corp. also has a port at the ready, and we had the opportunity to run some informal tests on it. Oracle7 does not take advantage of NT's built-in graphical performance monitor or security features, but its character-based interface will be familiar to those already using Oracle7. Performance is very strong, although slightly slower than Oracle's NetWare port reviewed in this story. This is to be expected; any NLM enjoys the advantage of running at Ring 0.

MICROSOFT SQL SERVER FOR NT

Microsoft Corp., which did not submit a product for formal review in this story, planned to release SQL Server for NT shortly after NT became available. Though Microsoft SQL Server and Sybase SQL Server emerged from the same code base, Microsoft SQL Server for NT is much more than a

direct NT port of Sybase 4.2. It has been fully rewritten to take advantage of the multithreaded NT architecture. In addition, Microsoft has fixed a number of flaws in the original 4.2 design and added a set of graphical monitoring and administration tools.

SQL Server for NT has a huge capacity. Like Sybase SQL Server, it can support up to 1,024 users. But while Sybase can only address 64MB of memory, Microsoft's NT product can address 2 gigabytes of memory and up to 8 terabytes of disk storage.

TIGHT INTEGRATION WITH NT

Since Microsoft makes both the operating system and the database server, the two are unusually well-integrated. SQL Server for NT can take advantage of NT's auditing and security facilities. Instead of logging on twice—once onto the operating system and again onto the database—you can set up the database so you only have to log on once. SQL Server for NT can share the NT user accounts and groups, simplifying administration.

The new graphical Performance Monitor hooks into the network monitoring engine built into NT itself. In addition to using it to monitor network activity, database administrators can use it to track cache hits, percentage of free transaction-log space, I/O statistics, locks held, CPU utilization, user

connections, disk utilization, and other performance statistics across multiple servers. Using NT's Performance Monitor event support, you can trigger an automatic dump of the transaction log to tape whenever the log goes above a certain percent full—an especially useful feature.

Two new DBA tools are bundled with SQL Server for NT: SQL Object Manager and SQL Administrator. SQL Object Manager lets DBA's manage database objects such as tables, views, stored procedures, and triggers. An interactive script generator builds SQL Data Definition Language (DDL) statements from existing databases so you don't have to save the original script used for database creation. SQL Administrator provides DBAs with a user-friendly front end for adding users, managing disk space, performing scheduled or on-line backups, and other administrative functions.

The use of threading in SQL Server for NT has been completely overhauled so that the product can take advantage of NT's symmetric multiprocessing; Oracle's NT port shares this advantage. The OS/2 version of Microsoft SQL Server, which we reviewed a year ago, is multithreaded but doesn't use native OS/2 threads. Instead, an internal scheduler handles the multithreading and the database

OPTIMIZED FOR WINDOWS FRONT ENDS

SQLBase is designed to be used with graphical, Windows-hosted front-end database apps where data is often viewed in scrollable windows. While most SQL databases can only move forward in result sets, SQLBase supports both forward- and backward-scrollable cursors at the engine level. Windows users view data at their leisure without interfering with concurrency or, alternately, losing updates.

Scrolling backward and forward through data can be a difficult feature for

the back end to manage. If share locks are maintained while users are browsing through data, other users on the network will be blocked from updating and concurrency will suffer.

SQLBase addresses this danger by supporting two special isolation levels: Read Only and Release Locks. Read Only databases don't need any locks at all and so provide the highest possible level of concurrency. The Release Locks isolation level uses a share lock that is only long enough to read the data, and then releases the lock. The risk of Release

Locks is that someone else could update the data you're viewing in a scrollable window and you wouldn't know it. If you then tried to update the data, your update would be lost.

SQLBase provides an Update Notification and Protection feature to deal with this contingency. Each row is given a row ID for quick access to the row for updates and to check whether that row was changed since it was last fetched. To take advantage of this feature, the developer must use the row ID to tell SQLBase which row to update. If the row has

appears to the operating system as a single thread. The NT product uses native NT threads so it can distribute threads across processors and dynamically balance the CPU load.

Like the Sybase product, SQL Server for NT supports multiple protocols concurrently. So, for example, you can have an SPX/IPX client and a Named Pipe client both talking to the NT server at the same time. The network integration kit now includes TCP/IP support in addition to Named Pipes and SPX/IPX, allowing SQL Server for NT to connect to Unix systems.

Remote Procedure Calls (RPCs) can be made from SQL Server for NT to Sybase SQL Server (and vice versa). Open Database Server (ODS), a set of extensions bundled with the product, includes many additional features. For example, Extended Stored Procedures lets you extend the capabilities of Transact-SQL through NT DLLs. The DLLs can be called by stored procedures and triggers. With this feature, a trigger that monitors warehouse inventory levels could automatically notify a purchasing manager through electronic mail when stock is too low. Unlike OS/2, NT provides fault protection at the thread level rather than at the process level, so a bad DLL will only bring down the user thread accessing it.

A MULTITUDE OF FIXES

Several idiosyncrasies in Sybase SQL Server have been corrected in Microsoft SQL Server for NT. For

example, the lock manager has been rewritten to get around Sybase SQL Server's deadlock problem. With Sybase SQL Server, if a page is locked and two other transactions are competing for the page, both transactions go to sleep for a while and are then awakened at the same time. Whichever transaction gets there first gets the page—essentially a random selection. A transaction will not get priority for the page until it has waited five times. Microsoft SQL Server for NT uses a queue to provide first-come, first-served access to the page.

Another idiosyncrasy in Sybase SQL

later. In the original Version 4.2, no optimization is performed if there is no WHERE clause in a given SQL query. Version 4.8 and above will use an index if one's available, and Microsoft SQL Server for NT does so, too. Similarly, an ORDER BY clause in Version 4.2 results in a sort if a clustered index is not available. SQL Server for NT can take advantage of a nonclustered index if one exists.

Microsoft has also rewritten the I/O subsystem of the kernel, adding some features that Sybase will include in System 10. During database creation, SQL Server for NT can write multiple pages in a single I/O rather than just one page. There is also an improvement in data transmission across the network. If you're using Named Pipes, the packet size is negotiated rather than fixed at 512 bytes, and can increase to as much as 4K.

Since Microsoft SQL Server for NT was not shipping during our test cycle, we didn't include it in our formal performance testing. However, informal tests show that performance is excellent, much faster than OS/2 SQL databases and only slightly slower than the NLMs.

DBAs should certainly take a look at the new NT offerings. For those willing to commit to a complete NT solution, the Microsoft route may be the way to go. If flexibility is a concern, then Oracle7—with its ports to most major platforms and operating systems—is well worth investigating. □

INFORMAL TESTS SHOW THAT SQL SERVER FOR NT'S PERFORMANCE IS EXCELLENT, FASTER THAN OS/2 SQL DATABASES AND ONLY A BIT SLOWER THAN THE NLMs.

Server is its use of process connection time rather than transaction length to determine which transaction gets killed in case of deadlock. As a result, the wrong transaction is sometimes killed. This flaw, which will be fixed in Sybase SQL Server, System 10, has already been corrected in the Microsoft port. SQL Server for NT evaluates the resources taken and kills the process with the fewest number of locks or the least restrictive locks.

SQL Server for NT also fixes some quirks of the optimizer in Sybase's original Version 4.2 code base, adding features that Sybase SQL Server offers only in its Unix Version 4.8 and



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3M Reliability

Getting What You Pay For

by Sheryl Canter

Not only are SQL databases technically complex, their pricing is also complex. What you'll pay varies by the number of clients you want to connect and your choices among the often bewildering array of add-ons and options.

What's more, products that seem expensive at first glance appear much less so when you consider their speed. We look at SQL database cost in two ways: total dollars and price per transaction. Price per transaction is computed by taking the total cost and dividing it by the number of transactions per second (TPS) in the Random Read performance test. The value obtained is useful for ranking products on bang for the buck.

ADDING UP THE PIECES

Vendors differ greatly in how they package and price their products. For some, such as Gupta, the server software price includes the cost of the networking software. Others, such as Ingres, sell the networking component separately. Oracle takes yet another approach, bundling SPX/IPX along with the server software and selling TCP/IP as a separate package.

All prices shown (in the graph "Price by Number of Clients" and the Summary of Features table) include server software, minimal networking software, development software needed to use a 3GL programming language such as C, and the minimum technical support option that includes telephone support. Pricing is further broken out by

the number of installed clients. Ten increments are shown, ranging from 1 to 36 clients. All prices also include the cost of seven development packages, reflecting the typical size of a corporate development program.

Though Sybase has recently dropped its server prices, Sybase SQL Server still comes out as the most expensive package for 13 to 36 clients. This is due to the large jump

Watcom SQL was by far the least expensive product in this roundup, with DB2/2 costing only slightly more. SQLBase and OnLine track each other closely as midpriced SQL databases.

BANG FOR THE BUCK

When you factor server speed into the price, the differences between the products become much smaller,

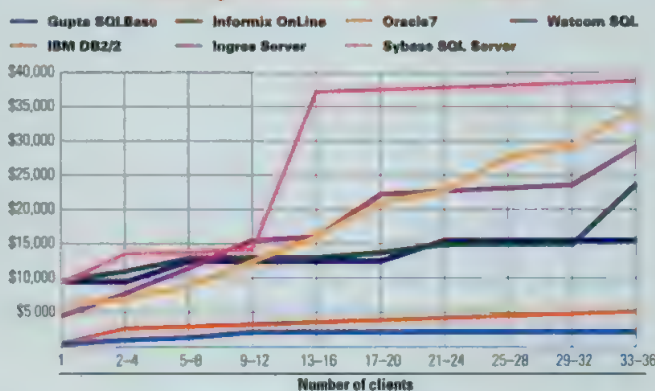
though the ranking is unchanged (see the graph "Price per Transaction"). We used the Random Read test as our indicator of performance, dividing the total price by the number of transactions per second achieved on this performance test. Ingres Server and SQLBase are missing from this chart because they could not complete the multiuser portion of our performance tests.

Oracle7 and Sybase SQL Server are still the highest-priced products, but by only a small margin because of their excellent performance. Sybase SQL Server's price jump above 12 clients makes it an expensive choice for 13 to 28 clients. DB2/2 does not appear to be so dramatically inexpensive on this graph, because of its slower speed. DB2/2 and OnLine are virtually identical in

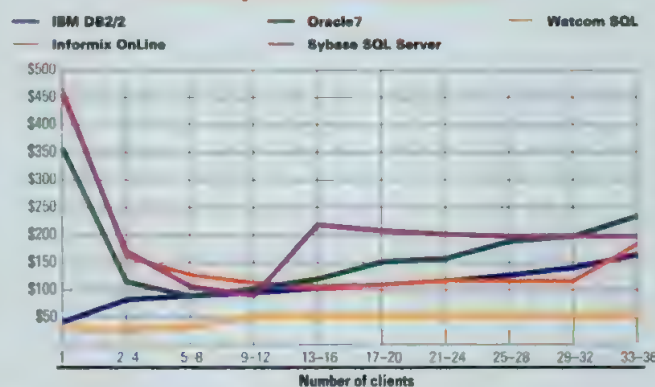
price per transaction, although OnLine costs more in absolute dollars. Watcom SQL is still by far the cheapest.

For less vital applications, the cheaper packages (in absolute dollars) look enticing. But if time is money, you may want to make the larger investment up front. □

Price by Number of Clients



Price per Transaction



in price after 12 clients, although at 36 clients Sybase SQL Server and Oracle7 are very close. After that, the Sybase product's price has topped out while Oracle7's continues to climb. Ingres Server's price tracks closely to Oracle7's, though Ingres Server is less expensive for more than 20 clients.

already been changed, SQLBase will prevent the new update and notify the application of the conflict, rather than just tossing the new update away.

SQLBase provides cursor context preservation so that graphical screens, which are slow to redraw, do not have to be refreshed as frequently. When a COMMIT is issued, the data is written out, and all share and exclusive locks are released. At the same time, all existing cursors are still positioned as they were before the COMMIT and can be used to process more rows. The application does not need to refetch all the rows across the network to get back to the position previous to the COMMIT, thus saving programming and overhead. Cursor context preservation works similarly with rollbacks.

SOLID FEATURE SET

SQLBase doesn't support triggers, but it does support DB2-style declarative referential integrity. SQLBase enhances this feature with three options: RESTRICT, SET NULL, and CASCADE. The RESTRICT option prevents deletions if they violate referential integrity. SET NULL updates reference data so that referential integrity is maintained. The CASCADE option deletes child records where necessary to maintain referential integrity.

The SQLBase optimizer comes with both cost-based and syntax-based features. The optimizer uses limited statistics (indexes, number of pages, number of rows) for cost-based optimization, but it also rewrites the query syntax for greater efficiency. Exactly what the optimizer collects and how it uses the information to come up with an access path is only touched upon in the manuals, which have very little meat to them.

SQLBase provides a variety of other advanced features, including support for BLOBs (binary large objects)—bitmaps or sound objects, for example—and on-line backup. Call-level APIs are available for both C and COBOL, along with a pre-compiler for COBOL aimed at cross-

developing for DB2. The precompiler is only available as part of Gupta's SQL System Programmer's Toolkit, which lists for \$995. SQLBase cannot store procedures with branching logic, but it can store compiled SQL commands that can be chained together linearly.

To use space in the log file efficiently, changes to the database are recorded at the field level; most SQL databases record changes at the row level. Log files can be stored on a separate device from the database to reduce contention. The databases themselves can be partitioned—stored on more than one physical file—to distribute the load across multiple devices and to increase capacity for large databases.

ACHILLES HEEL

We found large databases, however, to be SQLBase's weakness. Last year, it took SQLBase 10 hours to load and index our test database, far more time than any other vendor's product needed. Still, its post-load performance was excellent because of its dynamic hashed indexing. This year SQLBase took 60 hours to load our new, larger database and then wasn't able to index the tables; the server crashed every time we tried. Gupta is working on a new and faster loader, but it has not yet been able to identify the cause of the server crashes.

One of the improvements in the maintenance releases since we last looked at SQLBase is in the memory requirements of the client-side networking software. The Gupta kernel on the server takes up only 700K, and each client connection requires just 50K more of server memory. In contrast, the client-side memory requirements were once a whopping 200K. The new client software version uses only 50K of low memory, letting you load the rest into extended memory.

ADMINISTRATION AND FEEDBACK

SQLTalk, available in both character-mode and graphical versions, provides database administrators with a menu-

FACT FILE

Gupta SQLBase Server for NetWare, Version 5.12

Gupta Corp., 1060 Marsh Rd., Menlo Park, CA 94025; 800-876-3267, 415-321-9500; fax, 415-321-5471



List price: Server software, connections to 36 clients, Corporate Edition of development package, telephone support, \$15,490

Server requirements: 386-based PC or better, 2.5MB RAM, 2.5MB hard disk space, NetWare 3.x.

In short: Gupta SQLBase Server for NetWare choked on our moderately large test database and could not complete our tests; it is not the product for large, enterprise-wide computing. It is, however, well adapted for use with graphical, Microsoft Windows—hosted front-end applications. This, combined with a rich feature set and reasonable price, make Gupta SQLBase a good choice for small and moderate-size departmental databases.

 ON READER SERVICE CARD

driven tool for creating databases, setting permissions, and performing other administrative functions. The manuals are weak, however, describing each command separately, reference-style, without an overview of how things work together.

Some performance information is displayed within SQLTalk, but the depth and flexibility of the information is limited. A full-featured tool for monitoring SQL-based performance, called SQLMonitor, has been developed by Client Server Factory in close cooperation with Gupta. Version 2.0 of SQLMonitor is expected to be released by the end of this year.

With its advanced feature set and PC-centric orientation, SQLBase is an excellent choice for small to medium-size applications, or for standalone development of DB2 applications. But if your database is large, you should look elsewhere.

IBM Corp.

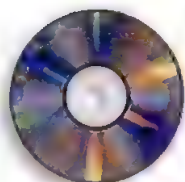
IBM DB2/2

This first release of IBM DB2/2 is essentially a 32-bit implementation of IBM's DB Manager, formerly part of the OS/2 Extended Edition product line. Like DB Manager, DB2/2 has an exceptionally

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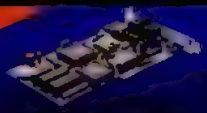
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▪ Distributed vs. Replicated Databases

by Richard Finkelstein

Many organizations now have databases distributed among multiple sites, yet they need to query and update them as though they were a single database. The classic solution is a distributed relational database management system (distributed RDBMS). These systems attempt to treat networks of databases as though they were local with respect to data consistency.

The problem with this approach lies not so much in theory as in hardware. Most wide area networks simply lack the speed and bandwidth to support the traffic needed for distributed transactions and joins. A failure at any one of the distributed servers also means that no transaction involving data on that server can occur anywhere.

These limitations are causing a shift toward another paradigm: replicated databases. Instead of attempting to synchronize dissimilar databases, replicated systems keep multiple copies of relevant data at every site where it is needed. Each system has its pros and cons.

PROBLEMS, PROBLEMS

As currently implemented, distributed RDBMSs pose a number of problems, quite apart from the obvious headache of supporting and administering geographically separated databases. Fundamentally, it is difficult to join tables that are located on different computers while still achieving acceptable performance. To execute a query, the distributed RDBMS must first locate the computers that contain the desired database tables and then determine the best way to retrieve the data from each individual database. Other factors include the selection of the best computer to use to join the data, and the cost of the network lines required. This process is called distributed query optimization. But even distributed RDBMSs with distributed catalogs and intelligent optimizers may not perform

well, because of network limitations.

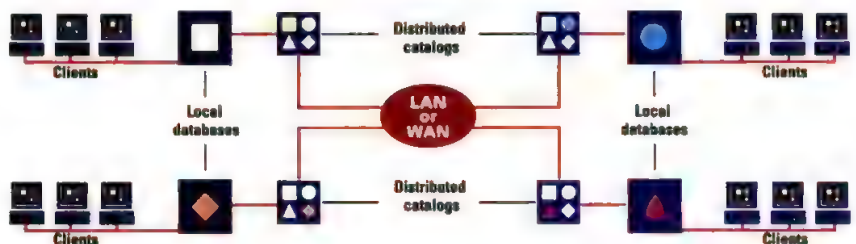
Another serious problem is maintaining database integrity when executing a transaction that updates multiple databases. If, for example, one of the databases becomes unavailable during a transaction, then all updates to the other databases must be rolled back in order to maintain synchronization.

Distributed databases implement a two-phase commit to manage this. The first phase prepares all databases for updates. The second tells the database to commit the transaction, physically writing the updates to disk. This can be

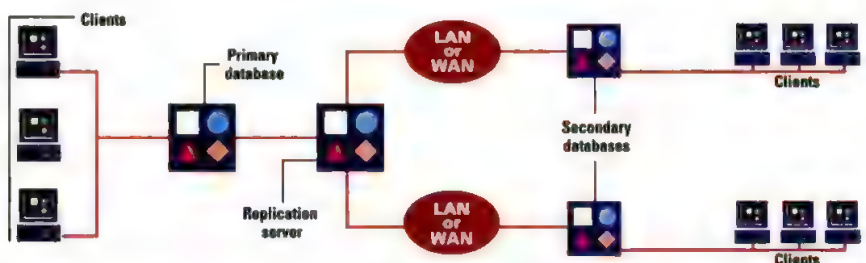
even when one site is down. In a data replication environment, a transaction updates a primary database first. The data is then replicated on secondary databases, which can be local or remote. Data replication can be performed immediately or can be deferred to some later time. If a secondary database server is not available because of unscheduled downtime, the replication is automatically deferred until the server becomes available.

Replication requires the same database structure at each primary and secondary node. Unlike distributed

Distributed Database



Replicated Database



a slow, expensive process when messages are being transmitted between remote computers. If one of the databases is not available, then all transactions associated with that database throughout the distributed environment grind to a halt.

REPLICATION PROS AND CONS

By putting copies of data at every site, replicated systems can make data available for transactions and queries

transactions, applications in a replication environment cannot update more than one site within a single transaction, because there is no two-phase commit.

Both distributed and replicated databases are difficult to manage, and there are currently very few deployed applications that actually use these technologies. As techniques and knowledge improve, distributed databases may get wider use. Today they should be approached with caution. □

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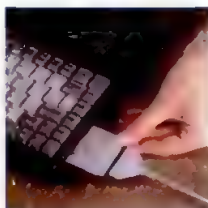
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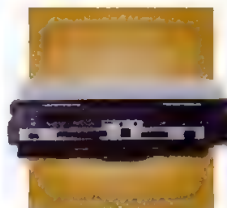
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- 5.7 pounds including battery
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low price and connects easily to a mainframe. Despite the name, DB2/2 does not yet fully qualify as an OS/2 implementation of the mainframe product DB2. In later releases, however, the two products will move closer together. Ultimately, IBM plans to make the DML (Data Manipulation Language) component of the two SQL dialects identical.

DB2/2 has a number of serious limitations. It requires databases to fit on one logical volume, which can involve major hardware expenses for a growing database. Also, the development and administration tools are designed for a 100 percent true-blue IBM shop. The precompiler is for OS/2 only; there is no DOS version. Also, the new IBM LAN NetView monitoring tool works only with IBM LAN Server.

CONNECTIVITY AND PERFORMANCE

DB2/2's biggest strength is its ability to connect seamlessly to IBM mainframes. While other vendors use gateways to connect, IBM employs a different technology; its DDCS/2 (Distributed Database Connection Service) software is based on IBM's DRDA (Distributed Relational Data Architecture) standard. Unlike gateway software, which must run on both the client and the host machines, DDCS/2 runs only on the client, making it significantly less expensive.

The advantage of gateways is that the information they store on the host enables distributed optimization. You may not need this feature, however. Many users simply download information from mainframes in order to do report generation or analysis on the cheaper PC platform. DRDA provides an inexpensive means for doing this.

DB2/2's LAN support is less advanced than its mainframe connectivity, however. It supports the NetBIOS protocol only. Surprisingly, there is no support for Named Pipes. TCP/IP and SPX/IPX support is planned for future releases but is not currently available. Furthermore, you

must use IBM's implementation of NetBIOS; the Novell version won't work. One factor that may have contributed to DB2/2's sluggish performance is its use of NetBIOS, which is a relatively slow protocol. NetBIOS is also difficult to route through WANs.

SUITABILITY TO TASK				
IBM DB2/2				
	POOR	FAIR	GOOD	EXCELLENT
Enterprise-wide apps	●	●	○	○
Departmental apps	●	●	●	○
Decision-support apps	●	●	●	○
Mission-critical apps	●	●	●	○
Transaction processing	●	●	○	○

Query test was good, but it came in close to the bottom on the Random Read, Random Write, and Mixed Workload tests.

DATABASE ARCHITECTURE

The most severe limitation of DB2/2 is that all database tables must be contained on one physical hard disk (though the transaction log can be stored on a separate device). This means that if a database grows beyond the size of your disk, you cannot simply add an additional hard disk; you must replace it with a larger one. And if your database is larger than a single disk can handle, you're stuck. IBM recognizes this as a serious problem and plans to correct it in the next release.

Another limitation is that the DB2/2 precompiler is only available on OS/2. If you want to use embedded SQL, you must do so within an OS/2 program. There is no call-level interface, though it too is planned for the next release.

Whenever you combine SQL with a 3GL like C, a bind must be performed that determines the access path used. Most SQL databases perform the binding on the fly in case the table structure or indexes have changed. With DB2/2, the bind process must be run as a separate step. While prebinding makes the embedded SQL appear to run faster, having to rebind explicitly after a structural change is an inconvenience for the administrator.

If you're using OS/2, DB2/2's Applications Remote Interface (ARI) lets you store compiled 3GL code written in C, COBOL, or FORTRAN. You can also

store REXX procedures on the server, and a precompiler for embedded SQL is available for all these languages. The ability to access OS/2 DLLs lets developers enhance the core functionality of DB2/2 if they're willing to do some programming.

DB2/2 supports a smattering of advanced features. Both cost-based and rule-based optimization are provided. The cost-based optimizer stores a wide array of statistics, though it does not store a histogram of the data as do Ingres Server and Sybase SQL Server. DB2/2 has no built-in auditing feature. Like DB Manager before it, DB2/2 supports declarative referential integrity, but there is no support for triggers, which are useful for enforcing business rules or as an alternative method for maintaining audit trails. On-line backup is not currently supported, but this is planned for the next release.

NEW TOOLS AND UTILITIES

The new LAN NetView (a separate purchase) gives database administrators a number of tools for which they formerly had to rely on third-party products. DBAs (database administrators) can view the status of transactions anywhere on the LAN. There are also tools for remote configuration, installation, and distribution. LAN

FACT FILE

IBM DB2/2, Version 1

IBM Corp., 1133 Westchester Ave., White Plains, NY 10604; 800-342-6672



List price: Server software (includes development software), connections to 36 clients, telephone support, \$5,083

Server requirements: 386-based PC or better, 8 MB RAM, 15MB hard disk space, OS/2 2.x

In short: IBM DB2/2 is essentially a 32-bit port of the 16-bit IBM DB Manager database server. Databases under DB2/2 are limited to a single, physical device—a serious limitation. Most add-ons and enhancements to DB2/2 run only on IBM software, such as IBM LAN Server and OS/2. There is no precompiler for DOS. Still, its performance is adequate, the price is quite low, and DDCS/2 provides built-in connectivity to mainframes. DB2/2 is a good choice for IBM-only shops with small databases, or companies that need to connect to DB2 on the mainframe.

ON READER SERVICE CARD

NetView, however, works only with LAN Server; you can't copy files from the server to a NetWare client. Since we were running a NetWare network on our performance test-bed, we had to install the software on each station manually. IBM does not provide a performance monitoring tool for DB2/2, but it is working on an API to encourage third-party development.

Another new IBM product, called FFDC/2 (First Failure Data Capture), takes a snapshot of the system at the time of failure, and uses LAN NetView to transmit the information to the database administrator. This can be a big help to DBAs in diagnosing remote problems. Again, you need LAN Server to use FFDC/2, however, as it cannot run on a NetWare network.

IBM's newly released DataHub (also a separate purchase) lets you manage distributed relational databases, remotely granting security authorization and checking query status. Distributed computing is not yet fully implemented. DB2/2 cannot optimize distributed queries and has no support for two-phase commit (two-phase commit is implemented in DB2 on the mainframe).

The manuals for DB2/2 are written in the typical IBM Red Book style: There are lots of them, but they're poorly organized and don't give a good overview of the product. Technical support is provided free for two years from product purchase.

DB2/2's greatest strength is its ability to connect transparently with IBM databases on other platforms, especially mainframes. Although it is not a fast performer, it is one of the least expensive of the SQL databases, so it offers a good price/performance ratio. If you're not running LAN Server and OS/2, or if your database is growing rapidly, you should not choose DB2/2. It is best suited for IBM shops with a need to connect to mainframe databases.

Informix Software Inc.

Informix OnLine for NetWare

A highly tunable engine that has long been available on Unix platforms, Informix OnLine was released for NetWare this past January. This product, now at Version 4.1, was so long in development, however, that its feature set is

significantly behind that of its Unix cousin. Informix OnLine for NetWare provides no means for enforcing referential integrity at the server, its SQL syntax does not support primary and foreign keys, and there is no support for triggers. There is also no support for stored procedures.

All of these omissions will be rectified in Version 6, the next release for both Unix and NetWare platforms. Version 6 will be released for Unix by the end of this year; the NetWare version will follow about six months after that. A Version 5.01 port to Microsoft Windows NT should be out by the time you read this. Informix has no plans to support OS/2.

OnLine does have some strong features: a cost-based optimizer, mirroring of databases and transaction logs, on-line backup, engine-driven backward-scrollable cursors, cursor context preservation, and a complete suite of performance monitoring tools. It is also quite fast. Unfortunately, this first port to NetWare is not yet stable. We experienced repeated problems and server crashes during our performance testing.

FLEXIBLE AND TUNABLE

OnLine makes installation painless, even for beginners. The install program prompts you for your skill level—beginner, intermediate, or advanced—and then asks for different information depending on your selection. Beginners are asked only for basic information such as the number of users and the size of database; advanced users are asked about log buffers, shared memory, and other technical parameters. Appropriate defaults are set for the information you do not supply. Later, you can go back and fine-tune the server for your specific needs.

OnLine's easy-to-use menu-driven monitor, DB-Monitor, is run as an NLM on the server and is used to set the engine's many tunable parameters for optimal performance. It also provides a multitude of statistics to aid in tuning,

such as cache hits, disk reads and writes, checkpoints, locks, and user status. Unfortunately, these statistics are available only as DB-Monitor screen output. Unlike Oracle7 and Sybase SQL Server, OnLine does not store the information in virtual tables that can be accessed through SQL commands and stored in files. This feature is planned for the next release.

Tunable locking models—for record, page, table, and database—let the database administrator maximize concurrency and minimize overhead. Locking levels

are also unusually flexible, as they can be set on a table-by-table basis. This means that lookup tables that never change can use table-level locking, frequently updated tables can use record-level locking, and large tables

or tables with medium to light update activity can use page-level locking—all within the same database.

OnLine's checkpoint architecture is similarly flexible. You can force checkpoints by time (for example, every 15 minutes), by the percent of the log that's full, or through the DB-Monitor utility. While checkpoint forcing cannot prevent a long-running transaction from filling up the transaction log, the ability to force a checkpoint when the log is full is a convenient safety option. Usually when the log fills up, all processing stops until the DBA fixes the problem.

Though there is a cost-based optimizer, it collects only limited statistics for its cost estimates: the number of rows, available indexes, and maximum and minimum data values. It does not collect histogram information on the data, instead assuming a uniform distribution between the maximum and minimum values. Then the optimizer exhaustively searches all possible access plans, assigns a cost, and picks the cheapest plan for execution.

OnLine supports transparent access to distributed databases on multiple NetWare servers, and includes a global optimizer. But you have to stick to NetWare servers; since TCP/IP is not supported,

SUITABILITY TO TASK			
Informix OnLine for NetWare	POOR	FAIR	GOOD EXCELLENT
Enterprise-wide apps	●	●	● ○
Departmental apps	●	●	○ ○
Decision-support apps	●	●	● ○
Mission-critical apps	●	○	○ ○
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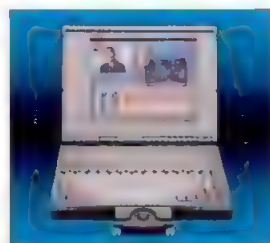


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► **S U M M A R Y O F F E A T U R E S**

CONTINUES

Client/Server Databases

Products listed in alphabetical order

■ = YES □ = NO

	Gupta SQLBase Server for NetWare	IBM DB2/2	Informix OnLine for NetWare	Ingres Server for OS/2	Oracle7 for NetWare	Sybase SQL Server for NetWare	Watcom SQL, Network Server Edition
List price (tested configuration)	\$15,490	\$5,083	\$23,723	\$29,198	\$34,922	\$38,717	\$2,239
SQL Implementation							
ANSI compatibility:							
ANSI Level 2 with Enhanced Integrity Addendum	■	□	□	□	■	□	□
ANSI Level 2	□	□	□	□	□	□	□
ANSI Level 1	□	■	■	■	□	□	■
DB2 compatibility:							
DML compatibility with DDL referential integrity	Partial	Full	None	Full	None	None	None
Syntax compatibility enforced by DBMS	□	□	□	■	□	□	□
EBCDIC sorting	■	■	□	■	□	□	□
Supports BLOB data types	■	□	■	□	■	■	□
User can define completely new data types	□	□	□	■	□	■	□
User can define data types based on existing types with range limits	□	□	□	■	□	■	□
Supports advanced mathematical and statistical functions	■	□	□	□	□	□	□
Supports user-defined functions and operators	□ □	□ □	□ □	■ ■	□ □	□ □	□ □
Cost-based/rule-based optimization	■ □	■ ■	■ □	■ □	■ ■	■ ■	□ ■
Transaction Management							
Locking:							
Record-level	■	■	■	□	■	□	■
Page-level	■	□	■	■	□	■	□
Table-level	■	■	■	■	■	■	□
Adjustable for each table	□	□	■	■	□	■	□
Automatic lock escalation	■	■	□	■	□	■	□
Consistency levels supported:							
Cursor stability (record-level share locks)	■	■	■	□	□	■	□
Repeatable reads (records locked until checkpoint)	■	■	■	■	□	■	■
Multiversioning (updates not blocked by reads)	■	□	□	□	■	□	□
Release locks (transaction releases all locks)	■	□	■	□	□	□	■
Uncommitted reads (user can read uncommitted data)	□	■	■	■	□	□	■
Read-only databases	■	□	■	■	□	□	■
Cost-based deadlock detection schemes:	■	■	□	■	□	■	□
Engine can abort transaction causing the deadlock	□	■	□	□	■	□	■
Engine can abort via a timeout option	□	□	■	■	□	□	□
Programming Interface							
Includes a call-level interface	■	□	□	□	■	■	■
Host-language interface:							
Supports ANSI-compatible cursors	■	■	■	■	■	□	■
Embedded SQL languages supported	COBOL	C, COBOL, FORTRAN, REXX	AdA, C, COBOL, FORTRAN, Hyperscript	C	C, COBOL, FORTRAN	C, COBOL	C
Supports backward scrolling in result set	■	□	■	□	□	□	■
Preserves cursor context after COMMIT/ROLLBACK	■	■	■	□	□	□	■
Supports result-set inserts	■	■	■	□	□	■	■
User can insert, update, and delete using an array of variables	□	□	□	■	■	□	■

DATABASES
Client/Server SQL

► **S U M M A R Y O F F E A T U R E S**

CONTINUES

Products listed in alphabetical order

■ = YES □ = NO

	Gupta SQLBase Server for NetWare	IBM DB2/2	Informix OnLine for NetWare	Ingres Server for OS/2	Oracle7 for NetWare	Sybase SQL Server for NetWare	Watcom SQL, Network Server Edition
Programming Interface (continued)							
Stored procedure support:							
Procedure stored in database	■	■	□	■	■	■	□
Embedded select, update, delete, insert	■	■	□	■	■	■	□
Control and flow logic	□	■	□	■	■	■	□
Message and error-code handling	□	■	□	■	■	■	□
Accepts variables and returns values or messages	■	■	□	■	■	■	□
Supports row-at-a-time processing	□	■	□	■	■	□	□
User can call a stored procedure on a remote server	□	■	□	■	■	■	□
Performs binding and optimization before runtime	■	■	■	□	□	□	□
Offers WAIT/NOWAIT for lock to be released	■	□	■	■	■	□	■
Database Server Environment							
Database server architecture:							
Multithreaded architecture	■	■	■	■	□	■	■
Process-per-user architecture	□	■	□	□	■	□	□
Portability:							
DOS	■	□	■	□	■	□	■
Microsoft Windows	■	□	□	□	□	□	■
OS/2	■ (16-bit only)	■	□	■	■	□	□
Unix	■	■	■	■	■	■	■
NetWare	■	□	■	□	■	■	□
VMS	□	□	□	■	■	■	□
MVS	□	■	□	□	■	□	□
VM	□	□	□	□	■	□	□
Other	None	None	Microsoft Windows NT	Cray	Various	None	PenPoint
Networking protocols on reviewed platform	APPC, SPX/IPX	APPC, NetBIOS	SPX/IPX	NetBIOS, SPX/IPX, TCP/IP	SPX/IPX, TCP/IP	SPX/IPX, TCP/IP	NetBIOS, IP
Data Storage Features							
Allows database segmentation	■	□	■	■	■	■	■
Supports clustered indexes	□	■	■	■	□	■	□
Supports clustered tables	□	□	□	□	■	□	□
Supports hashed indexes	■	□	□	■	■	□	□
Database Administration							
Includes performance monitor	■	□	■	■	■	■	□
Performance information accessible through an API	■	□	□	□	■	■	□
Keeps tables and logs on separate devices	■	■	■	■	■	■	■
Supports duplexing or mirroring of journals	□	□	■	□	■	■	□
Automatic system recovery with journal logs	■	■	■	■	■	■	■
Automatic media recovery with journal logs	□	■	■	□	■	□	□
Database backup/recovery options:							
On-line backup	■	□	■	■	■	■	□
Incremental backup	□	□	■	□	■	■	■
Backup and recovery by database segment	□	□	□	□	■	□	□
Point-in-time recovery	■	■	□	■	■	□	■
Fast recovery options:							
User can specify wall-clock time between checkpoints	■	□	■	□	□	□	■

DATABASES
Client/Server SQL

S U M M A R Y O F F E A T U R E S

ENDS

Products listed in alphabetical order

■ = YES □ = NO

**Gupta SQLBase
Server for
NetWare**

IBM DB2/2

**Informix
OnLine
for NetWare**

**Ingres Server
for OS/2**

**Oracle7
for NetWare**

**Sybase
SQL Server
for NetWare**

**Watcom SQL,
Network
Server Edition**

Database Administration (continued)

User can specify number of log records written between checkpoints	☐	☐	☐	☐	☐	☐	☐
Indicates estimated time for recovery	☐	☐	☐	☐	☐	☒	☒
Indicates percentage of log full	☐	☒	☒	☒	☐	☐	☐
Indicates amount written to log	☐	☒	☒	☐	☒	☐	☐
Audit trail:							
Maintains audit trail automatically	☐	☐	☐	☒	☒	☐	☐
Creates audit trail via triggers	☐	☐	☐	☒	☒	☒	☐
Import/export file support:							
ASCII	☒	☒	☒	☒	☒	☒	☒
.DBF	☒ (import only)	☐	☐	☐	☒	☐	☒
.WKS	☐	☒	☐	☐	☒	☐	☒
Other	None	IXF	Binary	None	Btrieve	None	.DIF, SQL INSERT statements
Security:							
GRANT/REVOKE by user	☒	☒	☒	☒	☒	☒	☒
GRANT/REVOKE by user group	☐	☒	☐	☒	☒	☒	☒
Supports mirroring of database tables	☐	☐	☒	☐	☐	☒	☐

Connectivity

Distributed database support:							
Automatic two-phase commit	☐	☐	☐	☒	☒	☐	☐
Programmer-controlled two-phase commit	☐	☐	☐	☐	☐	☒	☐
Distributed cost-based optimization	☒ (limited)	☐	☒	☒	☒	☐	☐
Distributed recovery	☐	☐	☐	☒	☒	☒	☐
Distributed deadlock detection	☐	☐	☐	☒	☒	☒	☐
Gateways:							
DB2	☒	☒	☒	☒	☒	☒	☐
RDB/VMS	☐	☐	☒	☒	☒	☒	☐
Legacy databases supported:							
IMS	☐	☒ (read only)	☐	☒	☐	☐	☐
IDMS	☒	☐	☐	☐	☒	☐	☐
VSAM	☒	☐	☐	☐	☒	☒	☐
RMS	☐	☒ (read only)	☐	☒	☐	☒	☐

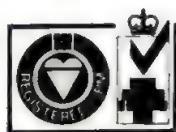
DBMS Integrity

Triggers:							
Executes triggers automatically for each modification to a table	N/A	N/A	N/A	☒	☒	☒	N/A
Supports multiple triggers for each type of modification	N/A	N/A	N/A	☒	☒	☐	N/A
Offers deterministic control over the sequence of triggers	N/A	N/A	N/A	☐	☒	☐	N/A
Triggers can cascade and trigger other triggers	N/A	N/A	N/A	☒	☒	☒	N/A
Supports recursive triggers	N/A	N/A	N/A	☒	☒	☐	N/A
Can apply rules to table columns	☐	☐	☐	☒	☒	☒	☐
Declarative database integrity:							
Supports cascading updates and deletes, using rules or syntax	☒	☒	☐	☒	☒	☒	☐
RI syntactically enforced by primary and foreign keys	☒	☒	☐	☐	☒	☐	☒
Maintains domain integrity	☐	☐	☐	☒	☒	☒	☒

N/A—Not applicable. This product does not have this feature.

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you cannot connect to databases on other platforms.

POWERFUL DATA MANAGEMENT

OnLine mirrors both databases and transaction logs to give protection in case of media failure; this powerful feature will be enhanced in the next release. Currently, OnLine writes to both primary and mirrored database areas but reads from only one, so you pay a penalty for mirroring when you write but gain nothing on reads. The next release will utilize optimized mirrored reads.

BLOBs are handled neatly by OnLine. Unlike other products with BLOB support, such as Sybase SQL Server, special areas on the disk, termed "BLOBSACES," can be set aside for binary data. This lets you tune the BLOBSPACE separately from the DBSPACE, setting the data page to a very large number in order to reduce the number of locks and disk I/Os needed to read the object.

You can directly transfer the contents of an operating system file to a BLOB column, and vice versa, without having to load the data into memory. Alternatively, you can read all or a portion of the BLOB into memory. This is a powerful feature, enabling you to store data in an unstructured form in the database and then retrieve portions of the data in terms of the BLOB's structure as defined by the front end. This is not a true user-defined data type such as Ingres Server provides, since the database is unaware of the BLOB's structure, but it is nonetheless quite powerful.

A unique and convenient feature of OnLine is its ability to export a table along with its indexes. Other databases support raw dumps but force you to recreate the indexes through SQL scripts. OnLine can dump both the data and index structures, letting you reload huge tables in minutes. This is very convenient when you need to update your hardware or rearrange tables on the hard disks. Even million-row tables can be dumped and restored in minutes, a feature we found useful during testing.

FAST BUT WOBBLY

While OnLine ultimately delivered impressive benchmark test scores, it had sig-

FACT FILE

**Informix OnLine for NetWare,
Version 4.1**

*Informix Software Inc., 4100 Bohannon
Dr., Menlo Park, CA 94025; 800-388-0366,
415-926-6300*



List price: Server software, connections to 36 clients, 7 Embedded SQL packages for development, telephone support, \$23,723

Server requirements: 386-based PC or better, 6MB RAM, 8MB hard disk space, NetWare 3.x.

In short: Though flexible and tunable, Informix OnLine for NetWare lacks many of the features that have become standard with SQL databases, such as stored procedures and engine-enforced referential integrity. Its performance was respectable, but we had to try many tries before we could get OnLine to complete our tests without crashing. We recommend waiting for the next release.

 472 ON READER SERVICE CARD

nificant problems running our performance tests. Only after days and days of repeated crashes were we able to obtain a full set of results.

Some of the system crashes occurred when the database engine was unable to obtain requested locks. If two clients attempted to insert records into a table at the same instant, the first lock obtained would not be released and the server would crash. We were able to get around this by adding delay logic to ensure that

A UNIQUE AND CONVENIENT FEATURE OF ONLINE IS ITS ABILITY TO EXPORT A TABLE ALONG WITH ITS INDEXES.

clients did not attempt to insert records simultaneously.

Another problem we encountered stemmed from Informix's Adjacent Key Locking scheme, which locks the next record in addition to the current record during INSERTs, UPDATEs, and DELETEs. This is necessary because of a design flaw in OnLine: The lock disappears when a record is deleted, even though it hasn't been committed. Thus,

if a second process inserts a row with the same unique key and the first process rolls back its DELETE, there will be two records with the same key—an integrity violation. With the extra locks required for Adjacent Key Locking, when all 36 clients in our test-bed attempted to update tables on the server many transactions failed to complete because of deadlocks. We got around this problem by adding logic that checked whether the lock was obtained and, if it was not, waited for a period of time and then tried again.

OnLine has a very sophisticated caching scheme; the cache is managed as multiple queues in memory. This allows for greater concurrency because only one queue of the cache is locked by a process, rather than the entire cache. Access is also quicker because each free-page queue is relatively short. The cache is periodically flushed to disk via a background thread called the page cleaner, which saves the checkpoint process from doing as much work.

Unfortunately, bugs in the page cleaner caused additional problems during our performance testing. If the page cleaner could not complete its task within 2.5 minutes, it timed out while still holding a latch in the database. Checkpoints that began after this point could not obtain a latch, because the page cleaner still held one. Behavior at this point was unpredictable. Sometimes the checkpoint record would become corrupted. Other times the server would crash. At still other times, the process continued to run but at a very slow rate. Since neither checkpoints nor page cleaners were writing out the buffers, cache buffers were only written to disk when data was forced out because a new buffer was needed. So in effect the server was operating without the benefit of a cache in these instances.

By setting checkpoints to occur more frequently and tuning the amount of work that the page cleaner must do—and by running the test repeatedly—we were finally able to obtain benchmark test numbers. The page cleaner did time-out during this run, but for some reason the checkpoint continued.

WORTH WAITING FOR

OnLine will eventually be a strong contender for high-end SQL databases on the NetWare platform. Virtually every aspect of the engine is tunable, and once we got it to run without crashing, it performed well on our performance tests. OnLine also has some unique options, and many additional features will be added to the next release. Well-written and well-organized manuals ease the learning process for new users. However, because of OnLine's instability, some remaining gaps in its feature set, and the dearth of front-end tools, we recommend that you wait for the next release before buying.

Ingres Corp.

Ingres Server for OS/2

When we last looked at Ingres Server for OS/2, its feature set was significantly behind that of the company's Unix version. This has changed with the latest release; Version 6.4 offers the same sophisticated engine and advanced feature set as its Unix cousin. Many of Ingres Server's features—such as event alerters and user-defined data types, functions, and operators—are unique to Ingres and not found in other SQL database products. A NetWare NLM version of Ingres Server is also under development.

Ingres Server was one of the faster performers on our single-user performance tests, but it could not complete our multi-user tests: Clients sporadically lost their connection to the server. Ingres attributes this to a bug and is investigating the cause.

SOPHISTICATED ENGINE

Ingres Server, which the company dubs the "Intelligent Database," is bundled with two extensions on the OS/2 platform: Ingres Knowledge Management (KnowledgeMan), and Ingres Object Management (ObjectMan). The database engine itself uses multithreading to keep host-memory overhead to a modest 30K to 50K per user. Because tables are in separate operating system files, Ingres Server can store databases across multiple hard disks, thus distributing the I/O burden. On-line backup is supported, though the engine does not yet support mirroring.

Built-in two-phase commit makes

SUITABILITY TO TASK				
Ingres Server for OS/2				
	POOR	FAIR	GOOD	EXCELLENT
Enterprise-wide apps	●	●	●	●
Departmental apps	●	●	○	○
Decision-support apps	●	●	●	○
Mission-critical apps	●	●	○	○
Transaction processing	●	●	●	○

Ingres Server especially well-suited for distributed databases; the only other SQL database with this feature is Oracle7. TCP/IP support, new with Version 6.4, lets you communicate with databases on other platforms. Ingres Server can be a "participant" in an Ingres/Star database (Ingres's distributed database), but it cannot be the Star server (sold separately). Ingres/Star supports distributed optimization—a sophisticated feature that is only just starting to appear in other SQL databases.

Ingres Server supports stored procedures, but with some limitations. You can't COMMIT in a stored procedure if it's called by a "rule" (Ingres terminology for triggers). Also, stored procedures can't call other procedures; there is no equivalent of Sybase's Remote Procedure Call functionality, though this is planned for the next release. New to the tested version is the ability to access stored procedures interactively; formerly you could only access them through embedded SQL.

Many of Ingres Server's most advanced features are part of the KnowledgeMan extensions. One of these is rules support. The number of nested calls and the number of rules that can be defined per table are both unlimited. Rules can also be called recursively, which is useful for "bill of materials"-type problems. Since Ingres Server does not support declarative referential integrity, rules are used both to maintain RI and to enforce business rules.

UNIQUE ENHANCEMENTS

KnowledgeMan's unique and powerful Database Event Alserter lets you define database events and the actions to be taken when the events occur. Even non-database applications can be launched so, for example, when inventory runs low,

you can have the server automatically send out a fax to reorder stock, or you can have summary reports automatically created at month's end. Event Alerters can also be used as a sort of burglar alarm for security purposes. Applications select the events for which they receive notification by registering with the database server.

The Access Control feature, which lets the database administrator assign permissions on a group, individual, or role basis, is also part of KnowledgeMan. Role permissions, an unusual innovation, let the DBA assign different permissions to users, depending on the application they are running. For example, an employee might be given write privileges when accessing a table through an accounting application, but read-only privileges when accessing that same table through a different application.

The Enhanced Security feature (a separate purchase) provides internationally standard B1-level security. An automatic DBMS-maintained audit trail is supplied for everything but retrievals. The audit trail will tell you when files were opened and closed, but it does not log the SQL statements that tell what was viewed, a feature necessary for C2-level certification.

FACT FILE

Ingres Server for OS/2, Version 6.4

*Ingres Corp., 1080 Marina Village Pkwy.,
Alameda, CA 94501-1041; 800-446-4737,
510-769-1400*



List price: Server software, connections to 36 clients, 7 Embedded SQL packages for development, telephone support, \$29,198

Server requirements: 386-based PC or better, 16MB RAM, 100MB hard disk space, OS/2 2.x

In short: Ingres Server for OS/2 has been upgraded to include the same feature set as the Unix version, but Ingres Corp. has not worked out all the kinks yet. Ingres Server was unable to complete our multiuser tests, because clients unexpectedly lost their connection to the server. Still, it performed well on the rest of our performance tests, and its feature set is top-notch. Look for the maintenance release

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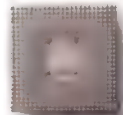
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Client/Server SQL

KnowledgeMan's Resource Control feature, which uses the cost-based optimizer to estimate requested resources, lets you limit the amount of resources that users can access. Resource Control prevents inexperienced users from locking up the system with runaway queries.

UNEQUALLED OPTIMIZATION

Ingres, which invented cost-based optimization, boasts the most advanced cost-based optimizer on the market today. Before any optimization is carried out, the query is "flattened," or normalized into a syntax-independent relational algebra. This ensures that the optimized access path is unaffected by the original syntax. Then the optimizer uses stored statistics to estimate the "cost" of different access paths.

In addition to the usual information on indexes, number of rows, and number of columns, Ingres Server collects statistics on the data itself in the form of a histogram. The coarseness of the histogram is determined by the amount of space available for storing statistics, a tunable option. You can also choose which of the tables to gather statistics on.

The ObjectMan extensions also add greatly to the power of Ingres Server. With ObjectMan, you can define new data types, user-defined functions, and user-defined operators. This powerful feature lets you manipulate spatial data and other complex types within the server itself. So, for example, you can select all customers whose address is north of a particular location, or you can specify lengths in a SELECT statement in terms of feet and inches rather than as a floating-point number. There is no server support for BLOBs. Ingres's front-end package, Ingres Windows 4GL, provides tools to simulate BLOB support, but access is very slow.

SOME TESTING GLITCHES

Ingres Server performed well in our single-user benchmark tests but could not complete our multiuser tests, because clients kept losing their connection to the server. Apparently the problem is not load-dependent. We tried having all 36 clients simply poll the server every 10 seconds; a third of the client connections had been lost after 8 hours.

Clients are connected to the server through the Ingres/Net communications package, which must be run on both the client and the server. Ingres/Net includes support for all available gateways and bridges. This is convenient, but you cannot do a selective installation, and its comprehensive functionality makes the client hardware requirements high—a 286 processor or better, 2MB of extended memory, and 6.3MB of hard disk space.

The Ingres Server manuals are better described as reference documents rather than as guides to using the system. While experienced users will appreciate the wealth of technical detail, concepts are not well explained. There are few examples, and there is no tutorial or overview of the Ingres architecture. To understand Ingres Server you'll need to wade through many manuals or obtain the services of an Ingres expert. To add to the difficulty, the same set of manuals is used for all ports, and thus contain information about parameters not relevant to the OS/2 port.

Despite Ingres Server's technological excellence in many areas, we would not recommend it at this time because of the showstopping multiuser bug we encountered. If you are interested in its unique functionality, hold out for the maintenance release.

Oracle Corp.

Oracle7 for NetWare

With some 18 months between the first preannouncement and the final ship date, Oracle7 was long in coming. Still, we found it to be well worth the wait. The NetWare version we tested blazed through our performance tests, leaving most of its competitors far behind. The many enhancements in Oracle7 include cost-based optimization, stored procedures, triggers, declarative referential integrity, and group-level security. Version 2 of SQL*Net, which will ship by the end of this year, will reduce Oracle7's large per-connection memory requirements by about a quarter. Even with the many new features that were added, we found Oracle7 to be exceptionally stable.

Oracle7, which runs on numerous plat-

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forms and provides gateways to many other engines, leads the industry in cross-platform support. A port to Microsoft Windows NT is under development as this story goes to press (see the sidebar "SQL on NT: Exploiting the Strengths"). Oracle7 is one of the few SQL database products to support two-phase commit and distributed optimization. You'll pay top dollar for it, but if you need a high-powered SQL database for storing large, mission-critical databases, you won't go wrong with Oracle7.

READ CONSISTENCY DEBATES

One of the most disputed issues in the SQL database industry is the proper way to ensure read consistency while multiple users are accessing and updating a database. Most SQL databases use share-level (read only) locks for this purpose. Oracle takes a different approach, a versioning methodology that ensures that the database appears the same from the beginning of a transaction to its end.

Oracle accomplishes this through the use of *rollback segments*. Updates are not blocked by share-level locks, but if a transaction discovers a changed record while reading through the database, it looks at the rollback segment to find the version of the data that existed at the precise time the query was started. The risk

ORACLE7'S SUPPORT FOR DISTRIBUTED DATABASES IS ESPECIALLY STRONG, WITH OPTIONS FOR BOTH TWO-PHASE COMMIT AND SNAPSHOT.

of this approach is that the rollback segments will run out of space, though this is a rare situation in practice. Rollback segments can be set to any size by the database administrator.

Oracle7's support for distributed databases is especially strong, with options for both two-phase commit and snapshots (data replication). Data replication is flexible; you can choose whether to replicate whole tables or individual rows. A distrib-

uted optimizer is used in order to speed cross-server joins.

NEW WITH ORACLE7

Until Oracle7, the Oracle server had only a rule-based optimizer. Oracle7's new cost-based optimizer stores numerous statistics, including some information on the data itself, along with the usual indexes, number of rows, number of columns, and other table-level statistics. The optimizer keeps track of the range, and the minimum and maximum values of data elements. It doesn't store histograms of the data as do Ingres Server and Sybase SQL Server, but histograms are planned for a future release. A "hinting" option lets you improve the optimization by passing to the optimizer information about the data that it wouldn't have otherwise garnered.

Rule-based optimization is also supported. Statistical- or rule-based optimization can be applied on a SQL statement, session, or system-wide basis. This gives you the option to hand-tune queries, and it also provides backward compatibil-

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ity with Version 6.0 databases.

Oracle7's new trigger support is unusually flexible. You can specify that triggers fire before the statement causing the trigger, after, or for each row. Event alerters are also new with Oracle7; clients can register to receive notification of different database events. The Oracle7 implementation of stored procedures is especially powerful. You can store packages of procedures and functions, rather than just single procedures. And you can create global variables that are accessible by the entire package rather than having to pass parameters. But unlike Sybase SQL Server, Oracle7's stored procedures cannot return multiple result sets.

In Oracle7, the access paths of previously submitted SQL queries are now cached in a common memory area called the "Shared SQL Pool." This technique gives many of the benefits of stored commands, with the difference that the Shared SQL Pool is filled on the fly. If a newly issued SQL query matches one already optimized and cached, the cached

SUITABILITY TO TASK				
Oracle7 for NetWare				
	POOR	FAIR	GOOD	EXCELLENT
Enterprise-wide apps	●	●	●	●
Departmental apps	●	●	●	○
Decision-support apps	●	●	●	●
Mission-critical apps	●	●	●	●
Transaction processing	●	●	●	●

version is executed and a step is saved. Otherwise, the SQL statement will be optimized and executed, and then stored in the Shared SQL Pool. Version 6.0 had separate caches ("context areas") for each user, and thus took more memory.

In addition to improving performance, Oracle7 makes things easier for the database administrator. The performance monitor, though still character-based, has been enhanced with optional pull-down menus. Performance statistics are also available through virtual tables that can be accessed via SQL SELECT statements. This lets you collect time-series data on

server performance to aid in tuning.

Oracle7 has group-level security, an important feature missing from Version 6.0. *User profiles*, also new with Oracle7, give DBAs extensive control over what a user can and cannot do. For example, a user could be allowed to update tables but not create them—or perhaps create tables of only a certain size or smaller. Or the DBA could limit a user to a maximum of 10,000 I/Os or two minutes of CPU time per query. Only Ingres Server has a similar capability.

The new built-in auditing feature lets DBAs track who's doing what, without programming. You can identify which user is executing a bad transaction, monitor the commands issued by a particular user, or track activities performed most often and tune the database accordingly.

In addition to many features other SQL databases lack, Oracle7 has virtually every feature offered by its competitors except for backward- and forward-scrollable cursors, mirrored databases, and user-defined data types, functions, and operators.

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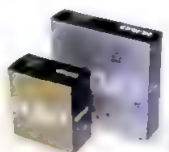
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DATABASES

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FACT FILE

Oracle7 for NetWare

Oracle Corp., 400 Oracle Pkwy., Redwood Shores, CA 94065; 800-672-2531, 415-506-7000; fax, 415-506-7200



List price: Server software, connections to 36 clients, 7 pre-compiler development packages, and telephone support, \$34,922

Server requirements: 386-based PC or better, 12MB RAM, 30MB hard disk space, NetWare 3.x

In short: Oracle7 for NetWare was long in coming, but it delivers on all its promises. Feature-packed, stable, and extraordinarily fast, Oracle7 packs the power needed for downsizing enterprise-wide, mission-critical databases. This new release adds a cost-based optimizer, declarative referential integrity, triggers, stored procedures, and group-level security. Though you will pay top dollar for it, Oracle7 delivers the goods

474 ON READER SERVICE CARD

A SPEED DEMON

All of our testing of Oracle7 was done with its new "discrete transactions" feature turned off, as some industry experts feel that discrete transactions are too restrictive to use in mission-critical production applications. Even without this optimizing feature, Oracle7 left most of its competitors in the dust. What's more, Oracle7 achieved its spectacular results with almost no tuning.

On the Mixed Workload test, for example, Oracle7 was so fast that it barely appears on the graph of the results. Sybase SQL Server was the only product to beat Oracle7 on any of our tests, soaring above Oracle7 in the Random Reads benchmark test because of its use of clustered indexes. But Sybase SQL Server was at 90 percent CPU utilization during this test, while Oracle7's CPU utilization was at only 15 percent. This suggests that Oracle7's random-read performance would respond excellently to a faster disk I/O subsystem.

One reason for Oracle7's exceptional performance is its read-ahead capability. It can read multiple pages into memory at a time, whereas Sybase SQL Server reads only one page at a time. Another reason is that its network component, SQL*Net,

can send large chunks of data across the network at once; the number of rows sent is tunable. Sybase SQL Server, in contrast, sends only 512 bytes at a time.

Oracle7 has well over 100 configuration parameters, but in most cases you won't need to change more than a dozen of them. New users can usually get away with the defaults, but Oracle7 is really meant to be used by professionals who need its flexibility to optimize the performance of large, complex databases.

Both neophytes and old pros will appreciate Oracle7's excellent documentation. The manuals are comprehensive and well-written, with detailed descriptions of concepts and many examples. The manuals don't stop at listing the available options; they show you how to use the options in different situations, and how to interpret diagnostic output, such as access plans.

If you don't need the power and cross-platform connectivity of Oracle7, you could select a lower-priced SQL database. But if you need a crash-proof engine for quick access to huge databases, Oracle7 is an excellent choice.

Sybase Inc.

Sybase SQL Server for NetWare

In the year since we gave Sybase SQL Server for NetWare our Editors' Choice, the product has seen only two maintenance releases, neither of which changed the engine itself. Despite being the only reviewed product without the advantage of a recent upgrade, Sybase SQL Server, Version 4.2, is still a strong contender. Among its most advanced features are a high-quality cost-based optimizer, stored procedures, triggers, group-level security, mirroring, and on-line backup. It is also

SUITABILITY TO TASK

Sybase SQL Server for NetWare

	POOR	FAIR	GOOD	EXCELLENT
Enterprise-wide apps	●	●	●	○
Departmental apps	●	●	●	○
Decision-support apps	●	●	●	○
Mission-critical apps	●	●	●	●
Transaction processing	●	●	●	●

DATABASES

Client/Server SQL

available on a wide range of platforms. Sybase SQL Server is a stable product and exceptionally fast—the only product to challenge Oracle7 seriously on our performance tests.

As we go to press, Sybase is also undertaking a round of price cuts. The price for an unlimited number of connections to the server will have dropped from \$29,995 to \$17,995 by the time you read this. Sybase is also considering a budget alternative to its base support plan, which is currently a mandatory \$7,000 per year plus 7.5 percent of the purchase price.

Sybase SQL Server, System 10, a major upgrade that will be released on Unix platforms by the end of this year, will not be ported to NetWare until sometime in 1994. System 10 promises improved on-line backup and support for replicated databases.

ENGINE OVERVIEW

With few tunables and broad-based front-end support, Sybase is easy to administer. But you have to learn its ins and outs for it to achieve the best performance. Unfortunately, the documentation doesn't explain many of the details and caveats, so knowledge of the engine must be obtained through hard experience.

There have been a number of small enhancements, distributed through maintenance releases, since we reviewed Sybase SQL Server a year ago. The Bulk Copy Program (BCP) is now available as an NLM and is consequently much faster. Sybase now also makes better use of NetWare, using the NetWare Bindery to obtain the network address of the server; you no longer need to set the address through an environment variable.

The core engine remains powerful and feature-rich. Referential integrity can be enforced by the use of triggers. Both database tables and transaction logs can be mirrored. On-line backup is available, though at the price of a significant performance hit; speed improvements are planned for System 10 in this area. Sybase SQL Server has an API for two-phase commit, but the API requires extensive coding. System 10, with its emphasis on replicated rather than distributed databases, will not support two-phase commit either.

In addition to supporting stored procedures, Sybase SQL Server also boasts Remote Procedure Calls (RPCs), a power-

ful feature that enhances distributed computing. RPCs can call nondatabase applications through the Open Server extensions (a separate purchase). For example, you could launch an e-mail application in response to a database event. Open Server must be set up as an additional back-end process and requires complex, multithreaded programming in C.

Sybase SQL Server can support TCP/IP and SPX/IPX concurrently; Apple Naming services will be added in the next maintenance release. This means you can have multiple clients, each using different network protocols, all talking to the Sybase server. RPCs can also be sent using multiple protocols.

Sybase sets the time between checkpoints by an estimate of the time it will take to recover the database. For example, if you give it a parameter of 20, a checkpoint will occur when Sybase SQL Server estimates recovery will take 20 minutes. But for long-running transactions, that strategy doesn't work well and the log can fill up. If there isn't room in the log for the checkpoint information,

FACT FILE

Sybase SQL Server for NetWare, Version 4.2

Sybase Inc., 6475 Christie Ave., Emeryville, CA 94608; 800-879-2273, 510-596-3500; fax, 510-658-9441

List price: Server software, connections to 38 clients, 7 packages for development, and telephone support, \$38,717

Server requirements: 386-based PC or better, 12MB RAM (16MB recommended), 60MB

hard disk space, NetWare 3.x

In short: Version 4.2 of Sybase SQL Server for NetWare is a high-priced, high-performance database that placed at or near the top of the group on our performance tests. Its feature-rich engine supports stored procedures, triggers, mirroring, and an excellent cost-based optimizer. Time-tested and stable, Sybase SQL Server is a good choice for large, enterprise-wide databases

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you will have to go through a long, involved procedure with technical support to recover your database.

SOME TESTING ANOMALIES

Though there haven't been major changes to the product since we last tested Sybase SQL Server, there have been major changes in our testing procedures. These changes brought to light some weaknesses which had been masked previously.

We found a quirk in Sybase's handling of nullable columns, and in so doing turned up a good example of how efficiency can be increased with a thorough knowledge of how the engine works. Sybase SQL Server handles updates differently for fixed-length and variable-length fields. Fixed-length fields can be updated in place, but variable-length fields require a DELETE and then an INSERT for the entire row. Sybase handles nullable columns as variable-length fields that can't be updated in place, even if they contain data. A simple fix—a check to ensure that the updated data is

the same length or shorter than the existing data—would allow Sybase SQL Server to update variable-length fields in place a good percentage of the time. Most SQL databases do this. OnLine goes a step further and checks to see if there is free space within the page. If there is, it will compact the page and then update the row rather than resorting to a DELETE/UPDATE.

Having to perform a DELETE/INSERT greatly inflates the amount of data that must be stored in the transaction log, increases the number of locks that must be held, and takes longer because the indexes must be updated. We found updates in place to be about three times faster than DELETE/INSERT transactions; Sybase SQL Server was one of the fastest when updating in place, and one of the slowest otherwise. The performance test scores we show for it are the faster numbers, obtained by making the columns NOT NULL.

The large number of locks used when DELETE/INSERT transactions were performed caused frequent deadlocks to

occur during our Mixed Workload (MXL) with Concurrent Updates test. The frequent deadlocks uncovered another problem: Sybase SQL Server consistently killed the wrong process. Sybase keeps track of how long a *process* has been running—user connection time—rather than how long transactions *within a process* have been running. The concurrent updates in our test were a stream of very short transactions, but the client processes issuing the updates had been running for 2.5 minutes when the MXL process was launched. Though the MXL transactions run longer than the updates, Sybase SQL Server consistently killed the MXL process rather than the updates process.

Sybase says this situation is rare in the real world, but recognizes it as a design flaw. Unfortunately, the problem is difficult to fix because Sybase's current PSS (Process Structure Status) has no place to store transaction time. The problem will be rectified in System 10.

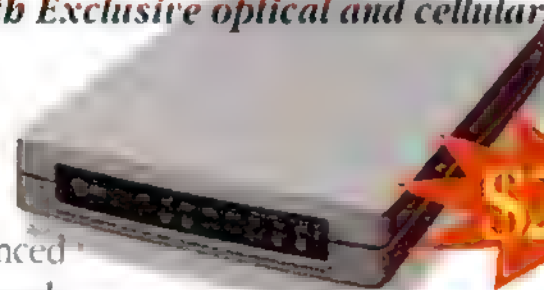
Despite these minor problems, we found Sybase SQL Server to be one of the most stable products we tested; it

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Client/Server SQL

handled our large test database with ease and turned in excellent performance results. With its advanced feature set and the large number of front-end tools that support it, Sybase SQL Server is an excellent choice for an enterprise-wide database.

Watcom International Corp.

Watcom SQL, Network Server Edition

While other vendors boast of upward scalability to larger computers, Watcom SQL finds its niche in the opposite direction: downward scalability that extends even to notebooks. The only DOS entrant in this roundup, Watcom SQL, Network Server Edition, Version 3.1, has modest hardware requirements. The 16-bit version can run on an 8088, and only 640K of memory is required; the 32-bit extended version will take advantage of whatever memory is on the server. Built-in data compression and encryption address the special security needs of notebook computers. There is even a version of Watcom SQL for GO Corp.'s PenPoint operating system.

Watcom SQL is also cheap—the least expensive product in this roundup. The standalone Developer's Edition, available for DOS or Microsoft Windows, retails for a mere \$795, and will be available at least through the fall for a discounted \$395—about what you'd pay for a file/server database. The only other SQL vendors that provide standalone versions for development are XDB Systems and Gupta. The 6-user network edition of Watcom SQL costs \$795; the unlimited-user version is \$1,595. The other SQL databases we reviewed cost many times more. Runtime support—a feature that no other vendor provides—is just \$99 and royalty-free.

Watcom SQL was one of the slowest performers on our performance tests, but because of its exceptionally low price, it has the best price/performance ratio (see the sidebar "Getting What You Pay For"). The mission of Watcom SQL is to make client/server databases accessible to the masses, and it goes a long way towards achieving that goal.

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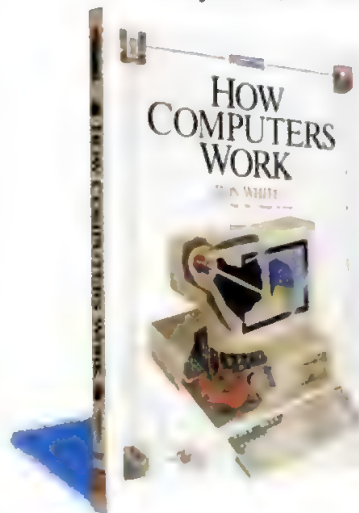
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Client/Server SQL

We caught Watcom between releases; Watcom SQL, Version 3.2, which adds cost-based optimization and on-line backup, was scheduled to ship in August. An OS/2 version of Watcom SQL should also be shipping by the time that you read this; versions for NetWare and NT are also in the works.

SOME ADVANCED FEATURES

Despite its compact size and low price, Watcom SQL contains a number of sophisticated features. It is one of the few products in this roundup—along with Gupta's SQLBase and Informix OnLine—that supports updatable, backward-scrollable cursors, a feature that enhances performance when using graphical front ends. Watcom SQL's security features allow the DBA to grant and revoke privileges by user or by group. Although Watcom SQL is DOS-based, its kernel still supports cooperative multithreading. Each transaction has its own thread; the number of threads in the server can be set by the database administrator.

In spite of the fact that Watcom SQL does not support triggers, referential integrity is supported syntactically, DB2-style, by the use of primary and foreign keys. But while operations that would cause a violation of integrity can be prevented, there is no built-in support for cascading updates or deletes.

The optimizer is rule-based rather than cost-based, but is unusual in its use of table

3.2 of Watcom SQL will have a full-fledged cost-based optimizer.

Mobile versions of the database can be made read-only, or you can use Watcom's DBTRAN utility to convert the transaction log into ANSI SQL statements for updating the server database at a later time. Of course, this will only work if most updates are not in conflict, such as when sales people on the road are entering new customer records. This unusual feature has many other potential uses. Though auditing is not built into the engine itself, DBTRAN can be used to audit usage. For example, you could examine all the transactions executed by a specified user. DBTRAN also enables selective restoration of the database up to a certain point in time.

Still, many features found in other SQL databases are missing in Watcom SQL. There is no support for stored procedures or triggers, which provide means for centralized, engine-driven enforcement of business rules. Watcom SQL cannot store BLOB data types, the format needed for image and sound data. Nor is there any support for on-line backup, mirroring, or distributed databases. All these features are planned for later releases of the product. On-line backup and BLOB support will be included in Version 3.2.

SLOW BUT STEADY

Watcom SQL installs quickly and has few tunables, but it pays for this in performance. Except for the Load and Index test, its performance test results were at or near the bottom of the heap of the products that we tested. Ad Hoc Query performance was especially poor, taking about eight times as long as the competition. But what Watcom SQL lacks in speed, it makes up for in stability. The package was like the tortoise in the old story of the tortoise and the hare, chugging along steadily, and ultimately finishing our testing program in fewer days than many other vendors, thanks to its stability and ease of use.

Watcom SQL's packaging and distribution scheme is as straightforward as the product itself. Everything you need is in the box, including the network requester and request manager, interactive SQL, and a simple, character-based front-end tool called ACME (Application Creation Made Easy). ODBC Level 2 (Open Database Connectivity) is included as a call-

FACT FILE

Watcom SQL, Network Server Edition, Version 3.1

Watcom International Corp., 415 Phillip St., Waterloo, Ontario, Canada N2L 3X2; 800-265-4555, 519-886-3700



List price: Server software (includes development software), connections to 36 clients, 7 run-time modules, and telephone support, \$2,239

Server requirements: 386-based PC or better, 640K RAM (2MB recommended), 1MB hard disk space

In short: Although the Network Server Edition of Watcom SQL, Version 3.1, is new to the SQL database market, it is surprisingly stable. Though its performance was slow, Watcom SQL's price is so low that it is still a bargain in terms of price per transaction. It doesn't have some of the advanced features that other products offer, but Watcom SQL is easy to install and configure—a good choice for small to medium-size departmental databases or for those looking to get their feet wet before plunging into the SQL pool.

476 ON READER SERVICE CARD

level interface, along with precompilers for embedded C/C++ programming with the Watcom, Borland, or Microsoft compilers. The standalone Windows version of Watcom SQL also includes a DLL for DDE (Dynamic Data Exchange). A subset of Watcom SQL for Windows, without the support for C/C++ programming, is bundled with PowerBuilder, a front-end development tool from PowerSoft Corp.

TEST THE WATERS

Watcom SQL is highly ANSI compliant, making it easy to port to other products and thus an excellent standalone development tool. You can use the \$99 royalty-free runtime engine to run custom applications without having to buy the full product. Watcom SQL is also a way to try out client/server computing at low cost and later move up to a more high-powered product if need be. Watcom SQL is not fast enough for an enterprise-wide database, but it's a good choice for small-to medium-size applications. Introduced only a year ago, its performance is sure to improve over time. Watcom SQL is a product to watch. □

SUITABILITY TO TASK

Watcom SQL

	POOR	FAIR	GOOD	EXCELLENT
Enterprise-wide apps	●	○	○	○
Departmental apps	●	●	●	●
Decision-support apps	●	●	○	○
Mission-critical apps	●	●	●	○
Transaction processing	●	●	●	○

size as part of the optimization scheme. It estimates the number of rows that will be returned and the number of I/O operations that will occur, based upon the size of the tables and the restrictions in the WHERE clause. Then it chooses the access path that it estimates will take the fewest I/O operations. This can be considered a very limited form of cost-based optimization. Version

Network Edition

THE LATEST NETWORK PRODUCTS AND MANAGEMENT TECHNIQUES

Specceing Out the Device Driver

by Frank J. Derfler, Jr.

With a new version of Microsoft's NDIS driver released with NT, network managers need to be more aware than ever of what these standards mean to them.

YOU'VE GOT A UNIX SERVER THAT HOUSES THE company's inventory and tracking systems, a NetWare or NT server that stores the files for the productivity applications, and users who demand access to the Internet. What are you going to do?

Resoundingly, the answer across the industry is to run multiple protocol stacks over a single network adapter using one of the device driver specifications. These application programming interfaces (APIs) enable users simultaneously to run multiple protocol stacks in their computers by carefully defining the interface between device drivers and network protocols such as IPX and IP and the LAN adapter.

With Windows NT, Microsoft released Version 3.0 of its Network Driver

Interface Specification (NDIS) device driver. NDIS 3.0's major enhancements include better overall performance and the ability to route incoming packets to more than one protocol stack. Novell's Open Data-link Interface (ODI) is a competing

specification that has wide acceptance.

While neither NDIS nor ODI are criteria for selecting one network operating system or another—particularly since there are ways of mixing and matching the protocol stacks and driver specifications

► NETWORK EDITION INDEX

First Looks:

Wellfleet's Backbone Concentrator Node (BCN)NE13
NetGuard's NSI 7000NE13
Cheyenne's ARCserve 5.0NE20
Microcom's LANlord 2.0NE22
Texas Microsystem's NetGENESIS 420NE26
Cubix's ERS/FTNE26

Network Peripheral's FDDI-over-UTP adaptersNE30
HP's EtherTwist HubNE30
New & Improved:
MFS' ATM networkNE35
IBM's ADSTARNE35
3Com's NETBuilder 6.1NE35
Lotus' cc:mail for OS/2 Workplace Shell 1.0NE36

Cabletron's FreeLINK/62 Wireless Ethernet HubNE36
ODS' 1094-UTPNE36
LANNET's LANswitchNE37
Intel's PC LAN Management solutionsNE40
Derfler & Greenfield:
To Switch or Not to Switch: The right choice for increasing network performance?NE47

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Matrix modularity means reliability

In some midrange UPSes, a small internal failure can bring down the whole UPS, and your system with it.

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Matrix modularity means low lifecycle costs

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neers for a midrange UPS

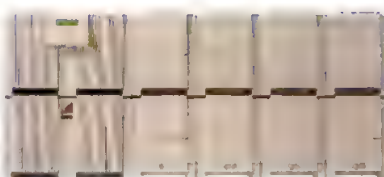
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Systems	Std	* Matrix	Std Runtime
10 Compaq SystemPro	5000		10 minutes
10 RS/6000s w/ 19" mon.	5000		10
15 386/33s w/VGA	5000		10
4 Sun 4/490s	5000		11

For midrange systems...

Systems	Std	Matrix	Std Runtime
2 DEC Vax 4000-500s	3000		12 minutes
3 HP 9000s	5000		11
IBM AS/400	3000		13
inc: 9406 E45 proc., 9337 DASD, 7208 tape, 3477 dis.			

* Shown as standard configuration. For additional runtime, simply add more SmartCells.

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Matrix provides auto-shutdown support of all major network, and midrange OS. The SNMP-compatible Matrix also supports APC's Measure-UPS which meters temperature and humidity, and monitors smoke, fire, water, and security detectors.

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with the operating systems—they remain critical factors in selecting the best products for your NetWare or Advanced Server installation.

A BIT OF HISTORY

Driver specifications grew out of a real need to provide some stability in the networking environment. Initially, every make and model of LAN adapter required a specific interface program, called a driver, to work with each brand and version of networking software. Companies tried valiantly to adapt their OSs and LAN adapters to each other. Novell owes much of the early success of NetWare to the library of over 30 different LAN adapter drivers shipped in each red box. Western Digital made strong early gains in the LAN adapter market by shipping each adapter with a floppy disk loaded with specific drivers for a number of network operating systems.

The driver has a few simple functions. It transmits and receives packets, sets the mode of the LAN adapter, and learns the

adapter's firmware-provided address. These functions are only difficult because of the different implementations of firmware on each make and model of adapter.

Today, if a company making LAN adapters only wanted to sell to the 32-bit LAN market, it would have to ship each adapter with drivers for NetWare 4.0, OS/2, UnixWare, VINES, Windows and DOS, Windows NT, and Windows 3.1. More importantly, the vendor would have to maintain and update each version of the specific driver as each operating system evolves.

The way around this support nightmare is to use a standard specification for driver software. Obviously, if LAN adapters use a standard driver architecture it's easier for companies to market their products and for you to select adapters from among many different vendors of adapters and operating systems. The secondary, but increasingly important feature of all of the standard packet specifications is the ability to load simul-

taneously more than one network communications protocol stack.

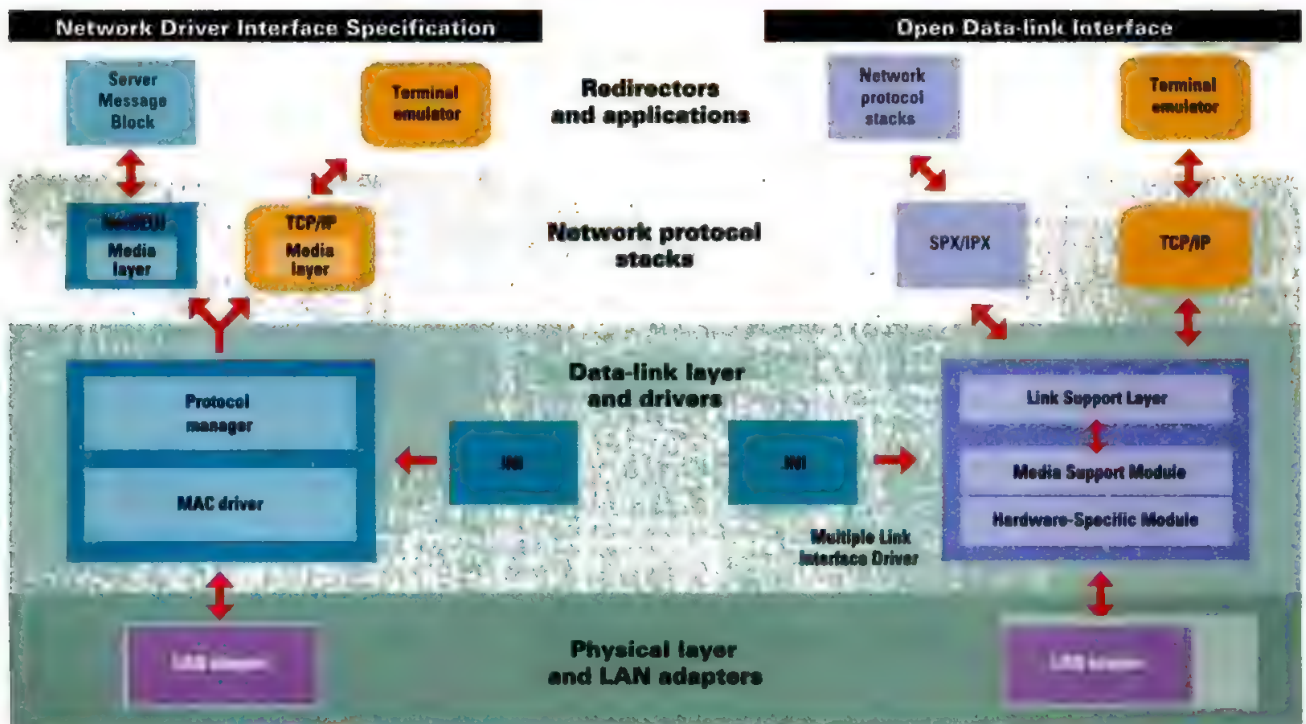
Originally a specification was released in the public domain called the pack driver specification (PDS). While it succeeded in garnering some following, PDS has been largely superseded by the newer specifications NDIS and ODI.

NDIS

Originally shipped in 1990, NDIS has become widely adopted by software and hardware developers. Banyan and Artisoft think enough of NDIS that they adopted the architecture for their client computers. And now, with Windows NT, Microsoft is shipping a new version of NDIS, NDIS 3, which is backwards compatible with the original NDIS and with NDIS 2.

NDIS uses a protocol manager, PROTMAN.DOS, which is an installer and handler for higher level network protocol stacks, a media-access control (MAC) driver for the specific LAN adapter, and a NETBIND utility that ties

Playing with Protocols



Though implemented differently, the Open Data-link Interface (ODI) and the Network Driver Interface Specification (NDIS) conceptually simplify network operation the same way: They tie multiple protocol stacks and network drivers together through a common interface.

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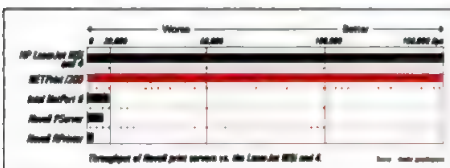
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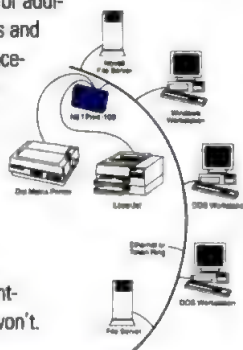
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Model	Network Connection	Network Operating System	Printer Connection (Serial or Parallel)	Memory	Price
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NETPrint/100	Ethernet 10BaseT and BNC Thicknet 4/10MB Token Ring (DIB and RJ45)	Single Novell	3-serial 1-serial 1-serial	512K ROM 512K RAM	\$795 (S) \$1,295 (T)
NETPrint/200	Ethernet 10BaseT and BNC Thicknet 4/10MB Token Ring (DIB and RJ45)	Multiple Novell Apple	3-serial 1-serial 1-serial	512K ROM 512K RAM	\$895 (S) \$1,495 (T)
JETXPrint/100	Ethernet 10BaseT and BNC Thicknet 4/10MB Token Ring (DIB and RJ45)	Single Novell	1-serial 1-serial	512K ROM 512K RAM	\$545 (S) \$795 (T)
JETXPrint/100	Ethernet 10BaseT and BNC Thicknet 4/10MB Token Ring (DIB and RJ45)	Single Novell	1-serial 1-serial	512K ROM 512K RAM	\$545 (S) \$795 (T)

*available 10/100 TCP/IP protocol 100/100/100



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everything together. The adapter vendor supplies the MAC layer and Microsoft supplies the rest. Microsoft Compatibility Labs tests and certifies the vendor's code.

There are three steps for loading NDIS. First, PROTMAN.DOS loads through the CONFIG.SYS file, then the MAC-layer driver and all the protocol stacks load. Then NETBIND, a utility, binds PROTMAN.DOS, the MAC-layer driver, and the protocol stacks together. A parameter file, PROTOCOL.INI, gives each program specific instructions and defines its DOS path.

Once loaded, the protocol manager acts as a relay station. After the MAC-layer driver strips off the outer packet information, the protocol manager sends the packet to each network driver in turn. NDIS 3 sends the packet to every stack. It does not quit after one acceptance as NDIS 2 did.

This change allows you, for example, to run two separate TCP/IP protocol stacks in the same PC. This is a useful capability in network management sys-

tems where a stripped-down and fast TCP/UDP stack carries management reporting data while a more complete TCP/IP stack carries other data with greater reliability.

The only really tricky aspect of using NDIS emerges if you inadvertently intermix NDIS versions from Microsoft, Banyan, and other companies—not difficult since they often load in different subdirectories instead of overwriting each other. Some companies that have adopted NDIS might not ship the latest versions of all the modules. Otherwise, the solutions to problems typically come down to editing line items in the PROTOCOL.INI file.

ODI

Novell released the ODI driver specification in 1989 and the first software shipped in late 1990 as a part of NetWare 3.11. ODI has become a major part of the infrastructure of NetWare. Products like LANalyzer for NetWare and the Novell Packet Burst Protocol rely on ODI as an

interface to LAN adapter boards. Novell is pushing strongly to make ODI available as an attractive interface under Microsoft Windows NT.

Prior to releasing ODI, Novell relied on the LAN adapter vendors to provide customized versions of the NetWare IPX drivers. The single IPX protocol stack reached from the application down to the adapter. (This application was typically the NetWare Core Protocols or other software using IPX services, such as a mainframe terminal emulator.) That's a strong and simple architecture, as long as you never change adapters or versions of the operating system. Novell ships only the ODI software in NetWare 4.0 and Novell Labs has stopped certifying pure IPX drivers, so ODI is Novell's recommended architecture.

ODI loads four distinct pieces of software into memory that connect the adapter board and an application. The Multiple Link Interface Driver (MLID) is specific to the adapter. It comes from the adapter vendor and typically carries the

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same name as the adapter, for example 3C503.COM for the classic 3Com Etherlink II adapter. This software handles the details of communicating with the LAN adapter.

***NDIS and ODI
are critical factors in
selecting the best products
for your NetWare
or Advanced Server
installations.***

The MLID itself has a top API and a bottom API. The bottom side, called the Hardware-Specific Module (HSM) is unique to the LAN adapter. The vendor of the LAN adapter is responsible for keeping this code up to date. The upper side of the MLID is the Media Support

Module (MSM). The source code for the MSM comes from Novell.

Because Novell maintains the upper part of this layer, the company can insure compatibility with the next higher layer of software, the Link Support Layer (LSL). The MLID strips the Ethernet, Token-Ring, ARCnet, or other MAC-layer bits from the packet and sends the packet up to the LSL. Think of the LSL as a traffic cop, because it can make decisions and route packets to any of several higher level protocol stacks that perform the task of formatting the application's data for transmission across the network. Among the typical higher layer stacks are IPX, IP, and NetBEUI. Applications such as the NetWare redirector, e-mail programs, or terminal emulators supply the data packaged by the network protocol programs above the LSL.

ODI gives you the same type of multi-protocol operation as NDIS does. Under NetWare, for example, you can load the IPXODI.COM program and the IPODI.COM program at the same time

and map DOS drive letters to NetWare IPX servers and to IP-based servers through the same LAN adapter. The ODI drivers and protocol stacks are each independent, and Novell has promised to keep the LSL compatible as the conduit between them. Novell tries to guarantee compatibility by certifying the vendor's higher layer network protocol and MLID products in the Novell Labs.

On the downside, ODI loads under DOS in the AUTOEXEC.BAT as a TSR. For that reason, it is as vulnerable to conflicts with other resident programs as any other TSR. The LSL, for example, tries to use the multiplex interrupt, 2Fh. Problems have been reported when LSL found that the first register address it tried was already occupied by another program and when other misbehaving TSRs jumped into the register address claimed by LSL. If you run into these problems, you're back to the painfully familiar process of changing the order of TSRs loaded in AUTOEXEC.BAT until you find a sequence that works. On the posi-

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tive side, because it is a TSR, you can unload the ODI stack by typing a command as simple as 3C503 U to regain memory under DOS.

Additionally, the configuration options for the ODI modules are held in a file called NET.CFG. Since the modules sometimes have a problem finding NET.CFG if the file isn't in the same subdirectory, it's generally a good idea to keep everything loaded together.

NDIS AND ODI COMPARED

You might think performance would be a factor, but it isn't. If simplicity is a guideline to performance, the PDS drivers should be the fastest, the ODI drivers quite fast, and the NDIS drivers the slowest. The daisy-chain activities of NDIS should, in theory, slow it down. However, Microsoft has taken specific steps to improve the throughput of NDIS drivers including providing specific macros and libraries to developers.

Microsoft includes MAC-layer code for fifteen specific adapters in Windows

NT, and the code for the NE-2000 works on dozens of different adapters. This code, written by Microsoft, is designed to use the smallest number of instructions possible, so it is as efficient as possible. In practice, the differences in performance among PDS, ODI, and NDIS products for any adapter are much more likely to be due to the ability of, and effort expended by, the programmer than to any inherent differences in the driver architecture. Strategically, the differences between NetWare and Windows NT Advanced Server are reflected in the driver specifications. Novell pushes for compatibility among network operating systems. In fact, there is a small program, called ODINSUP, that allows the full NDIS protocol stack to run on top of ODI. The benefit of this configuration is probably not evident unless you inherited an eclectic library that includes some protocol programs written for ODI and some written for NDIS, but it works. Novell makes it easy to run IPX, IP, NFS, and even newly

developed protocols for wireless communications over ODI.

Microsoft, on the other hand, pushes for cross-hardware operation. You'll find NDIS drivers available for RISC computers, Digital's Alpha computers, and other emerging computer systems. Microsoft is working with many vendors as it tries to ease the development of network communications programs and networking hardware for many different makes and models of computers.

By the way, if you already run your LAN adapters under the PDS, there are two programs, ODI_PKT and DIS_PKT, that let you load ODI and NDIS over the packet driver.

INTEROPERABLE ENABLERS

Overall, driver architectures aren't major buying factors. They are, however, key to developing interoperable networks. With NDIS or ODI you can connect with multiple servers, and without them you're left isolated in a single-protocol world.

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- Auto detects and uses 802.3 and Ethernet II
- Auto detects and attaches to new file servers
- Simultaneous queue server and PSERVER modes

TCP/IP FEATURES

- Finds IP address from BOOTP, RARP, or memory
- Supports LPR, RSh, Rexec, and standard TCP/IP connections to any TCP/IP host
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- Supports secure hosts with list of allowable IP addresses and subnet masks
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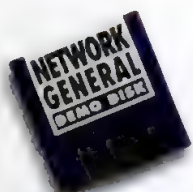
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FIRST LOOKS

HANDS-ON EVALUATIONS OF THE NEWEST NETWORK PRODUCTS

► ROUTERS

Wellfleet Introduces Ultra-High-End Router

BY ROBERT P. LIPSCHUTZ

Network architects have to make a tough choice: Either connect workgroups through a standard high-performance network such as Fiber Distributed Data Interface (FDDI) and be limited to 100-megabit-per-second (Mbps) throughput, or connect them through a high-performance router that may not have enough ports. Wellfleet offers the Backbone Concentrator Node (BCN) as a solution.

The BCN has all the power and scalability needed for building a collapsed backbone design in which the router—not an external FDDI network—connects workgroups together. In total, the BCN can connect up to 56 Ethernet networks, which is plenty for most networking environments, starting at \$24,000. If you need still more connectivity, multiple BCNs can be linked together via FDDI, making the BCN a strong central router as well.

Nevertheless, concentrating all connections into a single unit can give network administrators the shivers. Imagine a single component failure bringing down the entire network! The BCN tries to remedy that problem by supporting 13 hot-swappable communications boards. Should a module fail, the BCN can replace the offending board without downing the entire router. Redundant power supplies and dual bus controllers help insure that no single component failure will devastate your router.

Wellfleet's new software, Version 7.55, supports the hot-swappable com-

munications boards and dynamic reconfiguration, which allows on-the-fly configuration changes while the router is still in normal operation. Additionally, the software will automatically reset itself in the event of a software failure. All these features are new with the BCN and bring this router in line with the Cisco 7000, the new top-of-the-line router from Cisco Systems, the router market leader.

Wellfleet's Site Manager, a graphical router configurator, provides a friendly and powerful management interface. Routers have notoriously horrible user interfaces, but

Wellfleet combines the familiar front-end graphical interfaces of Windows 3.1 on the PC platform and Motif and

OpenLook on the Sun SPARCstation platform, making configuration more familiar. An informative graphical view of the router facilitates configuration and provides colorful information about ports and interfaces. Clicking on a particular interface brings up the configuration for that particular interface.

Unfortunately, Wellfleet ported its old code over to Site Manager, and the nested, disorganized structure of



UNFAIR ADVANTAGE: The BCN's high performance is fueled by a 1-gigabit-per-second backplane.

► NETWORK FAULT TOLERANCE

NetGuard's Alternative to SFT III

BY STEVE RIGNEY

Novell's System Fault Tolerance III (SFT III) software was once hailed as the first real step towards full server redundancy, but its price tag makes it a prohibitively expensive solution. NetGuard Systems is now offering the NetGuard NSI 7000, a fail-safe subsystem which, like SFT III, insures against hardware failures.

The key to the NSI 7000 is that the pri-

mary and secondary servers share the same fault-tolerant hard disk. Instead of using sophisticated code to synchronize two servers, the NSI 7000 boots a new server from this hard disk. While this process doesn't give nonstop reliability, it does make switching to a backup server virtually painless.

The NetGuard NSI 7000 package includes an external subsystem with two

Continues on page NE16

Wellfleet's earlier software remains. Furthermore, Wellfleet no longer has the command line interface preferred by some administrators, and out-of-band management, an important back-up management alternative, is only supported through a crude interface.

All communication between Site Manager and the router is done through Simple Network Management Protocol (SNMP) "gets" (viewing information) and "sets" (changing information), and Wellfleet has provided more than 2,000 management information base (MIB) variables to manage its router. Additionally, context-sensitive on-line help is available for most of the configuration choices.

Although a graphical management front end is appealing, the BCN's true value is under the hood. A modular chassis with 14 slots supports a System Resource Module for management and 13 communications cards, providing the largest port density available on the market today. For example, 13 slots populated with Wellfleet's Quad Ethernet cards give you a total of 52 network ports. Many varieties of communications cards are available supporting Ethernet, Token-Ring, FDDI, and Synchronous WAN.

Each communications card is supported by its own dedicated Fast Routing Engine processor board. When additional boards are added to the router, Wellfleet's Symmetric Multiprocessor Architecture ensures scalable performance through the BCN's high-speed 1-gigabit-per-second (Gbps) backplane. In contrast, the Cisco 7000 relies on a central processor to support all communications boards, which hinders scalability, as shown in our performance testing.

The BCN's high-performance scalable architecture leads to some exciting performance numbers. We found that the BCN attains more than 240,000-packet-per-second (pps) aggregate throughput for both IP and bridging in Scott Bradner's Harvard performance tests. Although the Cisco 7000 has not yet been tested in Bradner's labs, we tested the Cisco AGS+, the forerunner to the 7000.

The AGS+, using Cisco software,

Version 9.1, had a maximum aggregate throughput of 20,000 pps for bridging and IPX and 80,000 pps for IP. Because of this high aggregate throughput, the BCN passed close to 100 percent of six Ethernet streams, while the AGS+ passed only 20 percent of IPX and bridged packets, but did better with 80 percent of IP packets forwarded. Obviously, the BCN's symmetric multiprocessor architecture and 1-Gbps backplane prove too much for Cisco. According to Cisco, the 7000 should improve upon these numbers by about 30 percent due to software and hardware enhancements.

In tests involving Ethernet-to-FDDI translational bridging or routing, the BCN and AGS+ both struggled, with the

BCN routing 53 to 67 percent of offered packets, compared with the AGS+'s 21 to 81 percent. Wellfleet declined to participate in Token-Ring tests, perhaps indicating lower performance in this area.

As these test results indicate, the BCN shines with its multiple-stream Ethernet aggregate throughput capabilities, but must improve its FDDI and (presumably) its Token-Ring performance.

Wellfleet supports all the common network protocols (TCP/IP, Novell's IPX, AppleTalk, Banyan's VINESIP, DECnet Phase IV, Xerox's XNS, bridging, and source routing), as well as the popular LAN (Ethernet, Token-Ring,

Continues on page NE16

► The Other End of the Router Spectrum

There are two types of routers: central and peripheral. Central routers are those expensive, sexy boxes at the core of the network. Peripheral routers are the little, inexpensive, easy-to-install boxes that connect workgroups to the core site. While the Backbone Concentrator Node (BCN) makes a great central router, it doesn't really fit the bill as a good peripheral router. Wellfleet has positioned the new Access Feeder Node Token-Ring (AFN) to fill that role.

The Wellfleet AFN is bigger than you might like it to be, lacks some key creature comforts (such as a graphical management interface), and does not show the overall flair of its bigger Wellfleet siblings. Additionally, the AFN is pricey by low-end router standards. For these reasons, the AFN only makes sense if you already have other Wellfleet routers in your network.

With either one or two Token-Ring ports and two WAN ports in a fixed configuration, the AFN is designed for small remote sites. The AFN uses Wellfleet's software, Version 5.77, which is not the latest version in Wellfleet's rapidly changing software suite. Mixing software versions within a network means you give

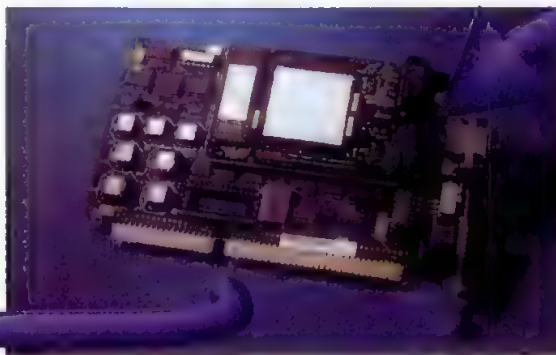
up the ability to manage your routers through one interface. Come November, Wellfleet will standardize on one version of software for its entire router line. Wellfleet also plans to unveil a new peripheral router in the near future that will target the Cisco 2000 market.

The AFN's best selling point is the BCN. Wellfleet is certainly selling from the top down, hoping that you'll purchase its high-end routers such as the BCN and then follow through with the purchase of its less-than-spectacular low-end products. Although Point-to-Point Protocol support allows interoperability between different vendors' routers over WAN links, it still makes sense to purchase routers from a single vendor since you'll only need to learn one router-management interface. Once the AFN uses the same code as the high-end products, it will make more practical sense for Wellfleet shops.

- List price: *Wellfleet AFN Token-Ring, 2 Token-Ring, 2 WAN ports*, \$8,995; *1 Token-Ring, 2 WAN ports*, \$6,995; *Wellfleet Communications, 15 Crosby Dr., Bedford, MA 01730*; 617-275-2400; fax, 617-275-5001.

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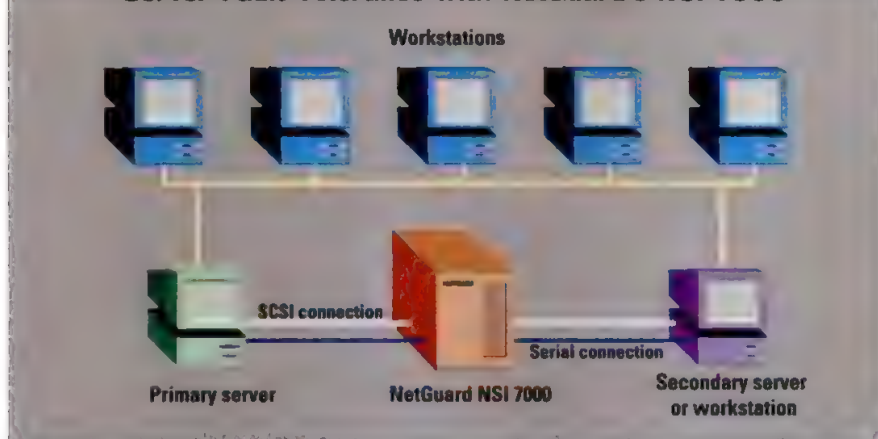
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Server Fault Tolerance with NetGuard's NSI 7000



With NetGuard NSI 7000, a secondary server or dedicated workstation takes over in the event of a hardware or software failure on the primary server.

NetGuard

CONTINUED FROM PAGE NE13

250-watt redundant power supplies and room for six SCSI hard disks. Two external SCSI connectors let the primary and secondary server share the NSI 7000. Two serial ports pass control information between the servers and the NSI 7000.

The NSI 7000 switches to a backup server based on SRVGUARD, a NetWare Loadable Module (NLM) that looks at various customer-specified thresholds and resources such as the server's CPU, memory, and power supply. The secondary server runs a DOS program called WSGUARD that monitors the information broadcast by SRVGUARD and switches over to the secondary server when it detects a problem.

During the switch from primary to secondary, the NSI system activates a SCRIPTOR NLM, which is a series of diagnostic utilities that includes NetWare's VREPAIR NLM. SCRIPTOR will attempt to repair any problems it finds on the primary server's hard disk volumes. When equipped with a modem, the NSI 7000 will also page the administrator.

COMPARED WITH SFT III

While the design and function of the NetGuard NSI are similar to that of Novell's SFT Level III, there are some important differences. First, the NSI 7000 does not guarantee full redundancy of the software running on the server: When a

failure occurs on the primary server, data being worked on will be lost. This could be crucial, especially during database rebuilds, when several files are open.

Second, under SFT III there is no downtime when moving between the primary and secondary server. Under NetGuard, the new server must start NetWare and come on-line, which could take a while, depending on your system's configuration.

Third, SFT III requires identical file servers with a special high-speed network connection between them. The NSI 7000, on the other hand, uses standard SCSI controllers and LAN adapters. However, these boards must have identical interrupt request and I/O base configurations.

SFT III is also more expensive: For 50 users, the software alone runs nearly \$7,500. Add the hardware in, and you're talking \$15,000 or more, compared with the \$8,995 charged for the NSI 7000.

The NetGuard NSI 7000 provides reasonably priced, high-quality protection for your data and hardware redundancy for your NetWare file server. For people concerned with network downtime—and even more concerned with their budget—the NSI 7000 can offer fail-safe operation for mission-critical servers.

• List price: *NetGuard NSI 7000*, \$8,995; *NetGuard Systems Inc.*, 3020 Old Ranch Pkwy., #300, Seal Beach, CA 90740; 310-799-5533; fax, 310-799-5590.

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Wellfleet

CONTINUED FROM PAGE NE14

FDDI) and WAN (frame relay, X.25, switched multimegabit data service, High Speed Serial Interface, Framed T1 and E1) protocols, but unfortunately does not yet support Point-to-Point Protocol (PPP), which allows inter-vendor WAN connections. Previous versions of Wellfleet's software supported PPP, and the vendor promises its return in the next version (7.60).

REALITY CHECK

Despite the impressive performance, this router is not for everyone—only the rich. The base price is \$24,000, and each interface card runs an additional \$13,000 to \$19,000. For a BCN supporting TCP/IP, IPX, and AppleTalk with one FDDI, 24 Ethernet, and eight synchronous ports, you're looking at about \$150,000.

For the amount of money you will spend, you will hope that Wellfleet improves on Site Manager, which still bears a resemblance to Wellfleet's previous convoluted interface. And you cannot use Site Manager to configure every router on your network: only the BCN and Backbone LinkNode are supported. Wellfleet promises that by November of 1993, released software upgrades will allow you to manage all of your Wellfleet routers through Site Manager.

With the Backbone Concentrator Node, Wellfleet has increased the stakes in the high-end router game. There's no question that the BCN is for serious router aficionados. If you're looking for a powerful central router to tie together far-flung workgroups or you are looking for a collapsed backbone router to connect local workgroups, this is the product for you. But even in these environments, we are concerned with the lack of PPP support and the archaic management interface.

• List price: *Backbone Concentrator Node: chassis*, \$24,000; *modules*, \$13,000 to \$19,000; *Wellfleet Communications*, 15 Crosby Dr., Bedford, MA 01730; 617-275-2400, fax, 617-275-5001.

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Sources, 6/93). Go ahead and link people to projects, notes to tasks, appointments to people and more, instantly. Commence's standard features include DDE Links to other Windows applications • Global Search • Letter Templates • Built-In Letter Writer • Powerful Import/Export Facilities • Auto Phone Dialer • Digital Telephony™ Support • Extended Sorting and Filtering • Built-In Gantt Charting

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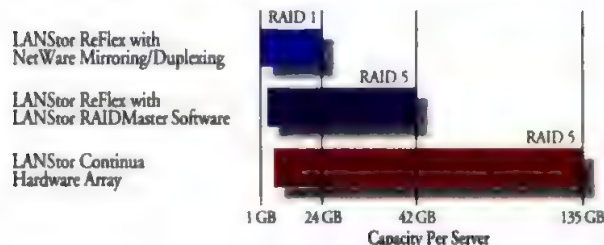
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NETWORK BACKUP

ARCserve Now Does Windows...and More

BY STEVE RIGNEY

Your data is only as good as your last backup, and your last backup is only as good as your backup software. Cheyenne Software's new ARCserve, Version 5.0 for NetWare, Windows Edition, is an ideal solution for backing up your entire NetWare, Version 3.11 or 4.0 LAN. ARCserve 5.0 sports a variety of improvements over previous versions, such as parallel streaming, which allows you to perform simultaneous backup and restore operations on multiple backup devices, and built-in support for NetWare Storage Management Services (SMS), Novell's standard for backing up NetWare LANs.

ARCserve runs on a file server from a series of NetWare Loadable Modules. Unfortunately, it does not yet support

NetWare 4.0's NetWare Directory Services (NDS), though support has been promised for a later release; it uses bindery emulation instead.

ARCserve can accommodate up to seven SCSI backup devices attached to the NetWare file server. It supports several different makes and models of SCSI controllers and the most popular tape backup devices, including 4-mm (DAT), 8-mm, quarter-inch cassette (QIC), and optical drives. We tested ARCserve 5.0 with an Always Technology IN-2000 SCSI controller and two Maynard DAT drives.

Installation is easy enough—if you have the correct drivers for your SCSI hardware. We had to obtain an updated driver from Always Technology in order to get ARCserve to run with the SCSI



CHECK THE DASHBOARD: The Job Monitor keeps you up to date on all aspects of your backup—from average throughput to elapsed time.

controller. ARCserve 5.0 uses a Btrieve index record to help you find files, but you will need to check your version of Btrieve: We had to download Version 6.1 through the NetWare service on CompuServe to complete the installation.

ARCserve 5.0 includes the agent software necessary to back up DOS, Windows, and OS/2 client PCs. Unix and Macintosh client software is available separately. Backup management is per-

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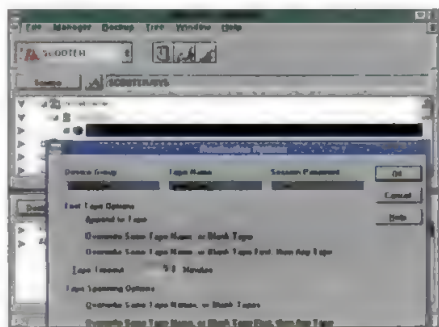
formed on a Windows PC. Using ARCserve 5.0's new Windows Quick Start program, you can start a backup with only three mouse clicks. Earlier menu-driven versions of ARCserve required as many as eight or nine steps to launch a backup. Performing backup and restore actions, scheduling automatic backups, and viewing detailed reports is simplified through the Windows interface. Btrieve makes searching for files using Boolean operators quick and easy.

With parallel streaming, you can perform a full file-server backup to one tape while you restore files to a PC from another tape. Any administrator who has worked through the wee hours of the morning backing up and restoring data will appreciate this feature.

ARCserve 5.0 is written to NetWare's SMS, which allows you to retain the OS/2 High Performance File System (HPFS) and Unix Name File System (NFS) name spaces during backup and restore. Eventually, this architecture should make ARCserve interoperable with other SMS-

compliant backup software and hardware products as they become available.

Cheyenne's unattended backup utility, Auto Pilot Tape Management, provides full automation for ARCserve 5.0 data backup and tape management. Auto Pilot includes a feature called Automatic Tape Rotation that guides you through daily, weekly, monthly, and even yearly rotation of active tapes. You can also use Auto Pilot's Disk Grooming feature to free disk



UNDER LOCK AND KEY: ARCserve, Version 5.0, allows you to password-protect your tapes and append or rewrite information to your backup media.

space on your file server. This utility moves outdated data off your hard disk and onto a tape.

ARCserve supports links to Cheyenne's InocuLAN virus scanner and FAXserve fax software. InocuLAN ensures that backed-up data is free of computer viruses. FAXserve can be used with ARCserve to fax alert messages and reports to the network administrator.

ARCserve provides complete backup capabilities for all of your networked PCs. Support for NetWare SMS and parallel streaming capability mark ARCserve as a product that should provide flexible and responsive service for a long time. ARCserve's Windows interface allows anyone to perform a network backup or restore without being an experienced network administrator.

• List price: ARCserve, Version 5.0 for NetWare, Windows Edition; 5-user license, \$395. Cheyenne Software Inc., 3 Expressway Plaza, Roslyn Heights, NY 11577; 516-484-5110; fax, 516-484-1853. Circle 965 on reader service card

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NETWORK MANAGEMENT

Microcom's New LANlord Adds Broader Support, Remote Control

BY BARRY NANCE

Once the exclusive domain of enterprise networks, standards-based management is currently making its way down into the workgroup, and LANlord, Version 2.0, is leading that charge. Microcom's latest version of its network management platform allows network administrators to build a relatively low-cost platform for managing Windows- or DOS-based PCs.

Like any management station that

systems, over-the-wire remote control based on Microcom's Carbon Copy for Windows utility, multiple LANlord servers, and remote editing of additional configuration files.

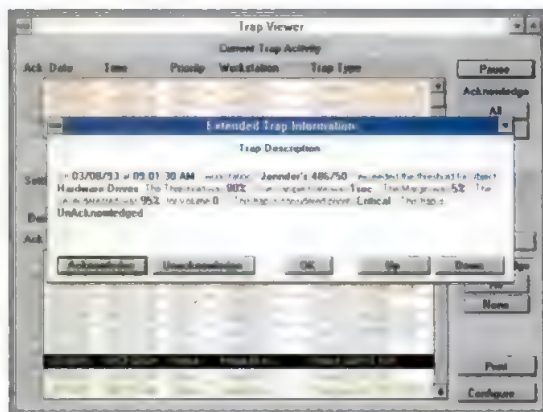
LANlord agents can also communicate with any SNMP-capable management console, such as Hewlett-Packard's OpenView. However, while HP OpenView uses enterprise-wide management consoles that are designed for multiple networks, The

LANlord network management system is aimed at individual sites, much like LANdesk, Intel's management platform. And while LANdesk works only with NetWare 3.11, LANlord 2.0 uses both IPX and NetBIOS to support NetWare, Microsoft LAN Manager, and LAN Server LANs. These network operating systems can all run over Token-Ring, Ethernet, or ARCnet.

An SNMP agent in the form of a 19K TSR runs at each DOS or Windows workstation;

an additional SNMP agent launches each time someone runs Windows. The agents report events (such as CMOS settings, memory usage, drive mappings, video adapter settings, open files, application software usage, and network packet statistics) to a central database running on an OS/2-based PC. LANlord's management interface component, a Windows application, gives network administrators access to the network management database and allows remote editing of workstation files. The administrator can even reboot a PC remotely through LANlord.

You can put users in different groups with different monitoring thresholds.



BAIT AND CAPTURE: Trap Viewer provides detailed descriptions of network traps.

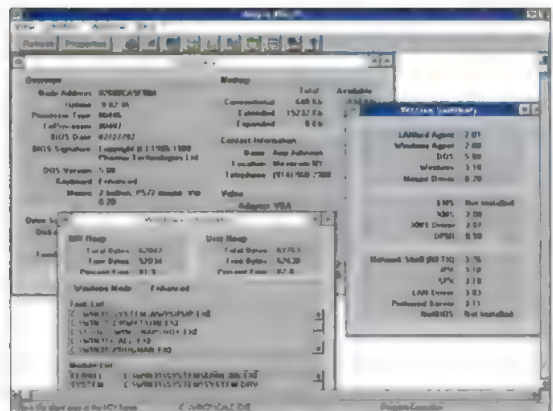
And the remote-control function lets you troubleshoot without ever having to leave your office. LANlord, Version 2.0, can forward workstation alerts through dynamic data exchange (DDE), Microsoft Application Programming Interface (MAPI), VIM, or even an electronic telephone paging system. Data can also be exported to Paradox or dBASE formats.

LANlord alerts that are generated at the client are reported in one of three states (critical, warning, or notice), and range from the usual Windows General Protection Faults and changes in a workstation's configuration files to virus detections. Unfortunately, however, the LANlord system doesn't have the ability to detect and report low-level network problems, such as a beaconing Token-Ring LAN.

Network management systems can save administrators lots of time if used correctly. LANlord is no exception: Its blend of end-station management, remote control, and SNMP management make it unique among low-cost management solutions. However, requiring an OS/2 platform and lack of support for Macintoshes may limit LANlord's appeal.

• List price: LANlord, Version 2.0, 10-user version, \$995; 20-user version, \$1,595; 50-user version, \$2,495; 100-user version, \$4,995; 250-user version, \$8,995; Microcom Inc., One Executive Blvd., #4, Yonkers, NY 10701; 800-822-8224, 914-968-2300; fax, 914-968-7100.

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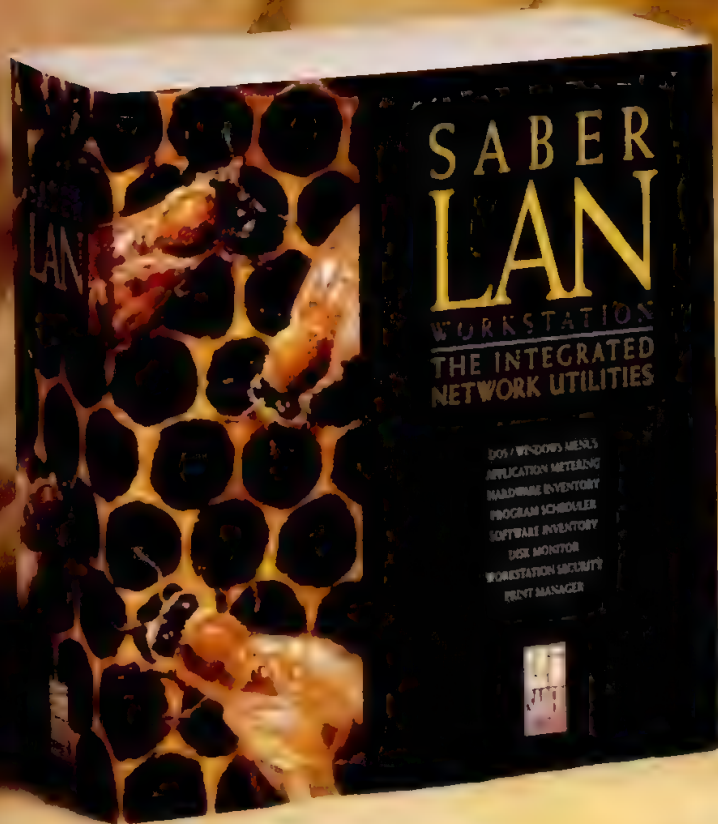


WEALTH OF INFORMATION: LANlord allows you to view myriad details on each workstation.

uses Simple Network Management Protocol (SNMP) for collecting information from network devices, LANlord is built around a monitor-agent architecture. Each workstation runs a small TSR (or agent) that allows administrators to collect inventory data, edit remote workstation-configuration files, monitor network traffic and other events, track application software license usage, and detect viruses. An SNMP console, the LANlord interface runs on an OS/2 platform and gathers and displays information.

LANlord, Version 2.0, introduces significant changes, including support for a greater number of network operating

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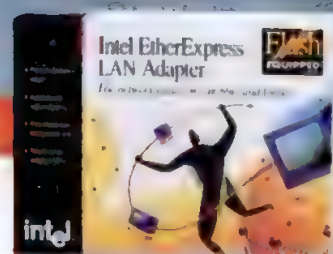
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number one card in a major adapter survey. To see what FlashC can do for you—and to learn about current promotions—call Intel's automated FaxBACK® service at 1-800-525-3019 and ask for document #9732. We'll put you in control in a matter of minutes.

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► COMMUNICATIONS SERVER

Texas Microsystems Releases Rugged 20-Slot Server

BY STEVE RIGNEY

Texas Microsystems' rack-mountable NetGenesis 420 PC can handle even the toughest of NetWare environments with industrial-grade durability and 20-slot expandability.

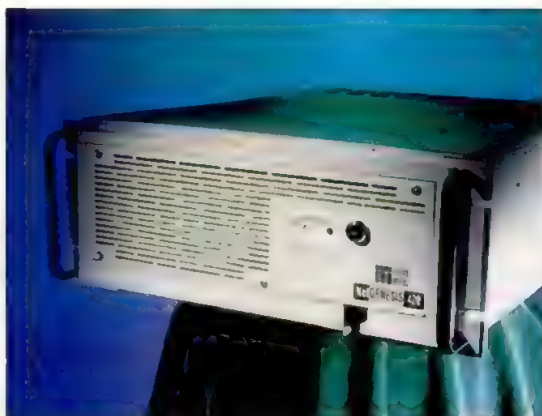
The NetGenesis series of PCs are designed for industrial use as internetwork servers for NetWare environments. The machines in the NetGenesis line range from an eight-slot model to a fault-tolerant system equipped with both redundant power supplies and mirrored hard disks.

Despite the obvious value of a 20-slot PC, the NetGenesis 420's most impressive feature is its rugged design. The NetGenesis 420 is built to withstand temperatures exceeding 110 degrees Fahrenheit and up to 95 percent humidity. Even heavy vibration is not a problem for the NetGenesis 420, since it is designed to continue operation after receiving a shock of up to 1g (gravity). The chassis contains five cooling fans, which provide ample ventilation, and a 300-watt power supply.

The NetGenesis 420 supports a wide range of Novell networking hardware and software, including the Multi Protocol Router; the NetWare Access Server; Hub Services; NetWare for SAA; and NetWare, Version 4.0.

Texas Microsystems also offers NetGenesis systems equipped with third-party network adapter cards. This option allows the NetGenesis 420, for example, to act as an asynchronous communications server, a remote or local router, a hub, and a file server.

Installing a router, hub, or access server in the NetGenesis 420 is as easy as first inserting the appropriate adapter card and then loading the software. Several



BUILT TO LAST: The NetGenesis 420 is designed to resist high temperatures and physical shock.

NetGenesis systems can be mounted in the same rack to centralize network resources while minimizing space requirements.

Our test unit was configured with a 486/33 CPU, a 40MB hard disk, 4MB of

RAM, two Intel 8-port hub cards, a Novell asynchronous communications card, and 3Com Ethernet adapters. Performance of all of the components was good, and each card functioned as it would have in a standard PC.

We actually found the NetGenesis 420 somewhat easier to maintain than some other standard PCs because it has a special industrial BIOS on the 486 daughter-card. The industrial BIOS allows you to disable both floppy controllers and I/O ports using software, without the need to change jumpers or dip switches. This BIOS also frees the unused interrupt request of the disabled device.

With a retail price of just \$4,395, the NetGenesis 420 provides approximately the same number of slots as three standard PCs—at a much lower price. The rugged design and expandability make it a good choice for remote network sites, in which space is usually limited and cost is crucial.

• List price: *NetGenesis 420*, \$4,395. *Texas Microsystems Inc.*, 5959 Corporate Dr., Houston, TX 77036; 713-541-8200; fax, 713-541-8226.

Circle 970 on reader service card

► COMMUNICATIONS SERVER

New Cubix Server Supports Eight PCs

BY STEVE RIGNEY

The new Cubix Fault Tolerant Enhanced Resource Subsystem (ERS/FT) lets you tuck as many as eight PCs into one fault-tolerant cabinet. These PCs can act as application servers, gateways, routers, hubs, communications servers, or file servers and help consolidate your internetworking needs.

The ERS/FT features redundant, hot-swappable 375-watt power supplies and a 16-slot, segmentable ISA backplane. It supports both 386DX/33 and 486DX/33 processors, which reside on Cubix Bus

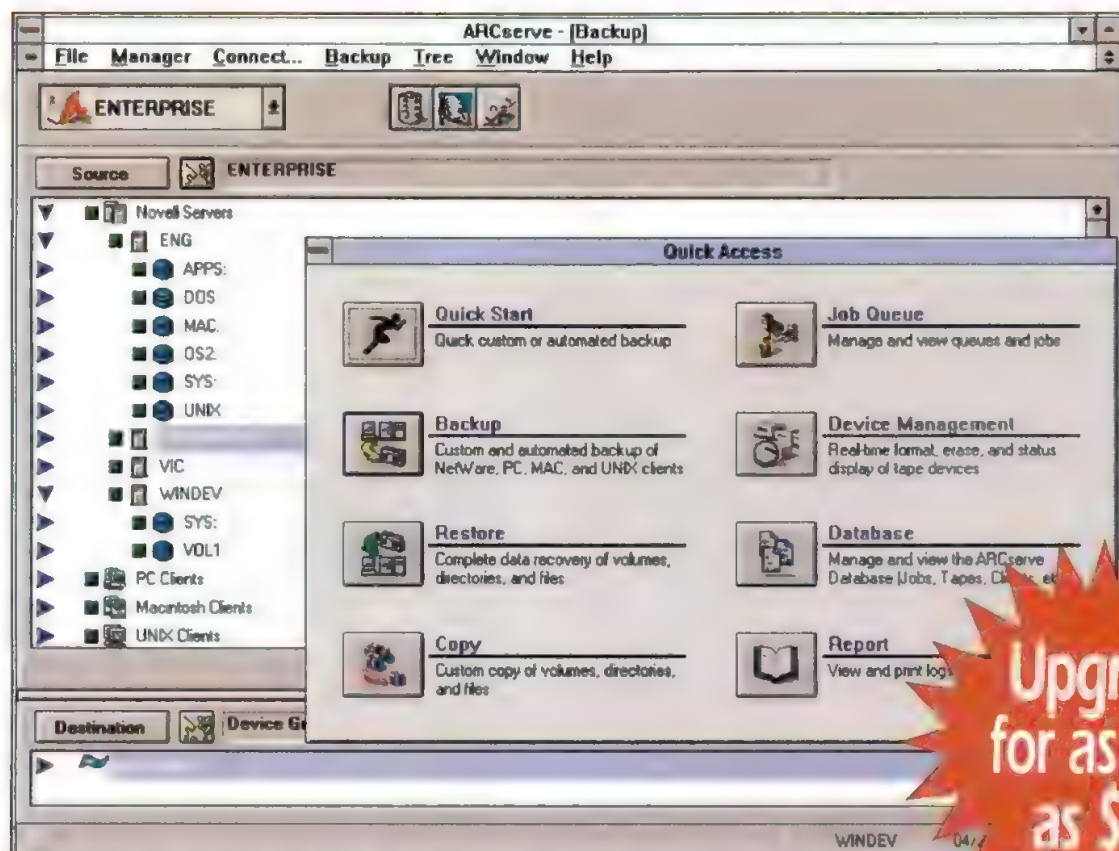
Controller (BC) CPU cards and are available separately. Each BC-series CPU card contains VGA, keyboard, and serial connectors as well as a built-in IDE controller. A single 1.44MB multiplexed disk drive serves every CPU card, so you don't need separate floppy disk drives for each CPU. There is also room for eight 3.5-inch hard disks and two large cooling fans.

The ERS/FT's main competitor, J&L Information Systems' ChatterBox/NRS, includes redundant power supplies and 14 slots for the same price. Like the Cubix, the J&L offers hot-swappable CPU cards, but you do not have to power off the bus



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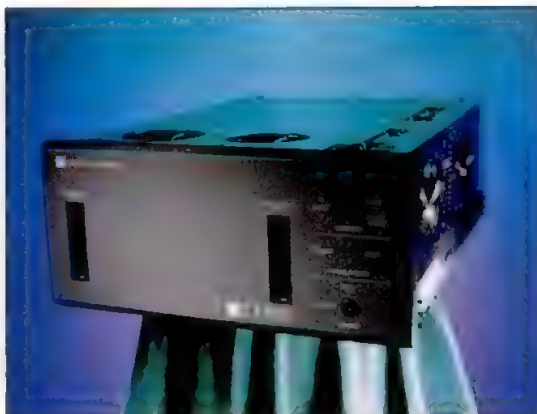
How About 300% Faster?

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segment before you swap the CPUs: You simply unplug the card. The Chatter-Box/NRS also offers a discriminate reboot feature, which allows you to decide if and when you want to reset a hung processor (the Cubix automatically resets any faulty CPU). Finally, the J&L offers SNMP-based management, currently unavailable for the ERS/FT, though Cubix is working on an SNMP application called CubixView, scheduled to be shipped this fall.

During our tests, we were able to change the slot configuration of the ERS/FT while running an application on an active processor. We also disabled the power and signal lines to specific slots and added more CPU cards without disabling the working CPU. We simultaneously ran Microsoft Windows, Windows for Workgroups, and IBM OS/2 on the CPUs without a problem. Overall, the system performed with no hitches and was easy to configure.

If you need to have even more processors at your disposal, you can place up to



PACKING THEM IN: The sleek exterior of the ERS/FT hides up to eight individual PCs.

four ERS/FT units in the Cubix System 1000 rack, which will let you control as many as 32 CPUs with one keyboard, mouse, and monitor. You can even link two System 1000s together to control as many as 64 CPUs.

The Cubix BC Series Supervisory System for the ERS/FT, which consists of a 386 BC CPU card called the Processor

Alert 3030 (PA3030) and BC Vision management software, monitors the status of every BC-series CPU card and can automatically send a hard reset to each individual CPU. You can manually reset and monitor the CPU cards from any PC or through a modem connection into the ERS/FT system. One PA3030 can manage as many as 31 CPUs in a Cubix System 1000.

Overall, we found the Cubix ERS/FT to be a versatile platform for consolidating your CPU power and software in a

single rack-mountable, fault-tolerant device.

• List price: *Cubix ERS/FT*, \$3,795; *386DX/33 BC CPU card*, \$995; *486DX/33 BC CPU card*, \$1,995; *System 1000 rack*, \$1,695; *Cubix Corp.*, 2800 Lockheed Way, Carson City, NV 89706; 702-883-7611; fax, 702-882-2407.

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► HUBS

High-Level Hub, Low-Level Price

BY JEFFREY L. CARRELL

Workgroup hubs can no longer survive on low price alone. User demands require that low-cost hubs incorporate as many high-level features as possible. HP's new HP J2355A EtherTwist Hub Plus/24 S offers port-level security, Simple Network Management Protocol (SNMP) manageability, and many other features normally found in larger enterprise hubs—all for about \$115 per port.

The J2355A is a standalone, 24-port hub offering 10BaseT, attachment unit interface (AUI), and BNC connectors; an RS-232 console port; and the hardware necessary for rack mounting. Two 50-pin connectors provide access to the 10BaseT ports. Connections are located on the rear of the hub, as are the LEDs for each port.

HP also unveiled the latest version of HP OpenView Workgroup Manager/Windows, its management software for DOS and Windows. It supports SNMP over TCP/IP or IPX and includes OV Draw, a separate package used for creating and configuring network maps. The management console can use one protocol at a time; you must choose between IP and IPX.

HP OpenView Interconnect Manager/Windows, a new add-on application for Workgroup Manager, allows you to manage the HP EtherTwist Hub series and third-party SNMP-compliant devices. The console offers a graphical "back-of-the-box" view for monitoring and graphing port statistics and for setting thresholds for special-case alerting. This view also features an MIB Browser utility that offers MIB-II or proprietary MIB extensions.

The hub's port-level security allows you to set each port to accept only authorized stations for connection. If an unauthorized station attempts to come on-line, the port gets disconnected and a trap is sent to the management console.

Our test network consisted of a J2355A, HP OpenView Workgroup and

Interconnect Manager/Windows, a 386SX/16 management console, a NetWare 3.11 file server, and a couple of workstations generating traffic. Performance was good on both the hub and the management console. Despite HP's recommendation of at least a 386/33 as the management console, our 386SX was able to keep up with the data coming in from the hub, even with multiple windows and graphs open.

The J2355A EtherTwist Hub Plus/24 S, combined with HP's improved management software, can play a key role in a secure, manageable network without detracting large sums from an already tight budget. HP is so sure of this product that it offers a lifetime limited warranty that includes coverage of the first five



LOW PROFILE: All of the J2355A's connectors are on the back of the hub and out of sight.

years with on-site repair.

• List price: HP J2355A EtherTwist Hub Plus/24 S, \$2,995; HP OpenView Workgroup Manager/Windows, \$2,000; HP OpenView Interconnect Manager/Windows, \$4,000; Hewlett-Packard Co., 8000 Foothills Blvd., Roseville, CA 95747; 800-752-0900, 916-786-8000; fax, 800-333-1917.

Circle 968 on reader service card

Driver Alert

The following table lists recently released software drivers and utilities from Novell. This software can be obtained from Library 9 (SOS Driver Alert) of the Utilities/Tips Forum on ZiffNet. A complete source of network technical support information, including technical articles, documentation, and supplemental software from leading manufacturers and software publishers, can be found in Support On Site, the monthly CD-ROM published by Computer Library. For information, call 212-503-4400.

File name	Size (kilobytes)	Release date	Title and description
COLD8T.ZIP	101	6/21/93	Novell Cold Boot Loader Patch Corrects a "Hole in File" error appearing on hard disks larger than 1,024 cylinders.
PATCH2.ZIP	89	6/18/93	Patch for NetWare 2.2 and 2.15: Fixes ABEND "Stack overflow" message.
LZW40.ZIP	146	6/18/93	NetWare 4.0 and NDS Decode Update: Contains decode information for LANalyzer for Windows 2.0 and NetWare 4.0.
NETMIG.ZIP	400	6/18/93	NetWare Migration Utility, Version 1.0: Includes tools to simplify the upgrade from NetWare 2.x to NetWare 3.11.
DDFDEF.ZIP	46,722	6/18/93	NetWare Management System Database Structure: Contains four data dictionary files that describe the NMS database structure.
PTF40.ZIP	420	6/18/93	Novell NetWare Compatibility Release (SAACH - PTF400): Updates for NetWare for SAA / NetWare 4.0.
OS2REQ.ZIP	30	5/13/93	Updates to the OS/2 Requester: Resolves problems that result in traps at the workstation and includes several other enhancements.
OS2LOG.ZIP	276	6/10/93	OS/2 Utilities for Correct Login Time: Fixes a problem with user logins between 12:00 P.M. and 1:00 P.M.
NLPAT.ZIP	23	5/27/93	NetWare Lite, Version 1.1 for DOS and Windows Patches: Contains patched versions of Compopen, Int17fix, Int28fix, Stackfix, and Videofix.
NIPU.ZIP	80	6/8/93	NetWare In-Place Upgrade from 2.x to 3.11 and 4.0: Uses NetWare 3.11 to upgrade a 2.1x or 2.2 file system and Bindery to a 3.11 file system and Bindery.

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► HIGH SPEED NETWORKS

Network Peripherals Adapters Deliver FDDI Speeds Without the Fiber

BY JEFFREY D. BAHER

With all the talk about Fast Ethernet, 100BaseVG, and Ethernet switching as low-cost, high-speed networking alternatives, it's easy to overlook Fiber Distributed Data Interface (FDDI) because of the costs associated with fiber media. Thanks to a new draft version of the FDDI standard (see sidebar), however, FDDI's 100-megabits-per-second (Mbps) transmission speeds are now available over unshielded twisted-pair (UTP). But while FDDI over UTP may be a viable solution for sites that satisfy the cabling

requirements, it by no means obviates fiber-based FDDI. Network Peripherals Inc. (NPI) is one of the first vendors to embrace this technology with the introduction of FDDI-over-UTP LAN adapters for EISA, ISA, Micro Channel, S-Bus, and VME bus architectures.

Since these products were the first of their kind to market, we tested them against FDDI-over-fiber adapters. On ZD Labs' NetBench 2.06 NIC Throughput test, 3Com's FDDILink Model 3C771 EISA adapter outperformed NPI's single-attached EISA

adapter, the NP-EIS-S50. With the exception of the largest block size, the FDDILink consistently delivered higher throughput and lower CPU utilization. With the 4K block size, the FDDILink still reported lower CPU utilization figures, but the NP-EIS-S50 reported higher throughput (see benchmark test results). The high CPU utilization makes NPI's adapters unlikely candidates for CPU-intensive servers, such as application or print servers.

■ FDDI over UTP: The Draft Standard

There are a number of proprietary FDDI-over-copper solutions, including Crescendo's Copper Distributed Data Interface (CDDI) and Chipcom's TPDI (Twisted Pair Distributed Interface), but FDDI over UTP is the only one based on the original ANSI X3T9.5 FDDI standard.

The FDDI stack consists of three layers: Media Access Control (MAC), Physical (PHY), and Physical Medium Dependent (PMD). The X3T9.5 FDDI standard calls for an Optical Data Link (ODL) at the PMD layer to convert electrical signals to light, and vice versa.

The new standard replaces the ODL with a

special UTP transceiver, which must be interoperable with other hardware: One vendor's LAN adapter must be able to communicate with another's concentrator. Unlike proprietary implementations, FDDI over UTP is standardized to guarantee PMD interoperability.

Network Peripherals and SynOptics have played crucial roles in developing the new standard and are rapidly expanding their FDDI-over-UTP offerings. Considering the marketplace's familiarity with UTP, the FDDI-over-UTP market is sure to heat up as vendors scramble to get involved. □

—Jeffrey D. Baher

Benchmark Tests: FDDI-over-UTP Adapters

In general, the fiber-based 3Com FDDILink Model 3C771 EISA adapter proved to be more efficient than the NPI NP-EIS-S50, registering higher throughput on all block sizes but 4K and achieving better CPU utilization results across the board. To gauge server performance, we ran both throughput and CPU utilization tests for each adapter in an eight workstation/one server environment. Our workstation test measured only throughput performance in a one server/one workstation setup.

The **NIC Throughput** test from NetBench 2.06 evaluates the amount of data that an adapter can transfer across the network in 1 second. A PC equipped with the adapter issues a series of read requests to a file stored in the server's cache. The test uses four block sizes: 64-byte, 512-byte, 1K, and 4K blocks.

NIC THROUGHPUT (SERVER)

Megabits per second	Block size ►	64 bytes	512 bytes	1K	4K
NPI NP-EIS-S50		3.03	21.42	40.59	89.72
3Com FDDILink Model 3C771 EISA		7.59	44.58	67.87	75.67

Higher scores represent better performance.

CPU UTILIZATION

Percent	Block size ►	64 bytes	512 bytes	1K	4K
NPI NP-EIS-S50		97.8	97.9	98.0	56.6
3Com FDDILink Model 3C771 EISA		93.0	83.0	71.5	23.2

Lower scores represent better performance.

NIC THROUGHPUT (WORKSTATION)

Megabits per second	Block size ►	64 bytes	512 bytes	1K	4K
NPI NP-EIS-S50		0.84	5.23	9.10	23.88
3Com FDDILink Model 3C771 EISA		1.14	6.52	11.03	19.81

Higher scores represent better performance.

NPI's Fiber Distributed Data-over-Unshielded Twisted Pair adapters, which ship with Open Data-link Interface (ODI) and Network Driver Interface Specification (NDIS) drivers, are capable of delivering high-speed connectivity, but FDDI over fiber still has its advantages: Longer transmission capabilities (2 kilometers versus 100 meters for FDDI over UTP) make it a better solution for wiring a campus network.

Some of fiber's other advantages include higher resistance to outside elec-

*Don't expect
that fiber-based
FDDI will disappear
anytime in the
near future
(especially with the
cost of fiber dropping).*

trical noise, better security from wire tapping, and support for greater bandwidth in the future (theoretical maximum throughput of fiber is 100 terabits per second). So don't expect that fiber-based FDDI will disappear anytime in the near future (especially with the cost of fiber dropping).

NPI's adapters succeed in delivering raw FDDI horsepower, but are best suited as cost-effective alternatives for bringing higher speed to the desktop, where they should compete more directly with Fast Ethernet and 100BaseVG solutions when they become available. For the time being, however, FDDI over fiber remains a more effective choice for campus backbones and servers—at least until vendors provide adapters with lower CPU utilization figures.

• List price: NP-EIS-S50, \$1,495. ISA, MCA, S-Bus, and VME versions: Contact the vendor for pricing. Network Peripherals Inc., 1371 McCarthy Blvd., Milpitas, CA 95035; 408-321-7300; fax, 408-321-9218.

Circle 969 on reader service card

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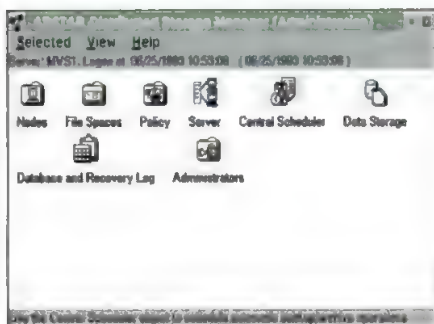
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NEW & IMPROVED

NEWS OF ANNOUNCED NETWORK PRODUCTS AND UPGRADES

NEW

Adstar Provides Multivendor Storage Management



AUTOMATED: Distributed storage management for multivendor environments.

Adstar, an IBM business unit, promises increased end-user productivity with the introduction of its new distributed storage-management solution for multivendor environments. The Adstar Distributed Storage Manager (ADSM) provides an automated solution for backup and archive needs in a distributed enterprise.

ADSM supports both IBM and non-IBM platforms, including Novell's NetWare, Sun Microsystems' SPARC and Solaris, and Hewlett-Packard Co.'s HP-UX. This cost-effective solution reduces LAN administration time and intervention. It also features

graphical and command-line interfaces for automatic backup, archive, recover, and query functions. Additionally, a recovery log is maintained to monitor all changes to the database.

• **List price:** *Adstar Distributed Storage Manager:* up to 10 users, \$22,500 one-time charge, \$470 monthly license charge; up to 100 users, \$45,000 one-time charge, \$920 monthly license charge. IBM Corp., 1133 Westchester Ave., White Plains, NY 10604; 800-426-2255. Circle 951 on reader service card

NEW

3Com Cuts Cost of Network Operation

3Com Corp. now provides simplified remote-office internetworking while reducing the cost of WAN ownership with a bevy of new releases for the NETBuilder family of routers and software, ranging from enhancements to existing products to new low-cost, remote-office internetworking systems. 3Com reduces costs in three areas: operation, acquisition, and management/administration.

In order to combat the rising cost of operating a network, 3Com is shipping multiple enhancements to its NETBuilder router software. NETBuilder, Version 6.1, includes data compression, which allows you to use lower-speed lines, and support for Integrated Services Digital Network (ISDN), which lets you control connection time. In February 1994, 3Com plans to add dial-on-demand capabilities for the Internet Protocol (IP) and Internet Packet Exchange (IPX) protocols.

3Com will reduce acquisition costs with its new modules for the NETBuilder II backbone router, which will reduce per-port costs by tripling the number of WAN connections to 24 and doubling the number of LAN connections to 16. Reductions in management/administration will come early in 1994 as enhancements to the boundary routing technology.

• **List price:** *NETBuilder, Version 6.1,* \$350 to \$2,000. 3Com Corp., 5400 Bayfront Plaza, P.O. Box 58145, Santa Clara, CA 95052-8145; 800-638-3266, 408-764-5000. Circle 952 on reader service card

HOT PROSPECT

MFS Implements First Operational ATM Network

MFS Datanet (a subsidiary of MFS Communications Co.) has announced the implementation of the world's first asynchronous transfer mode (ATM) network. That's right—ATM is really here. There's a working ATM network out there, and it spans 14 cities, including New York, Philadelphia, Boston, Dallas, and Los Angeles.

ATM is a set of international standards for sending large of amounts of data, voice, and video information simultaneously over a network using extremely high transmission speeds. Regarded as the future of high-speed networking, it provides increased and more efficient bandwidth, incorporating a fixed cell size and a high-throughput switching technology.

ATM is the backbone technology of MFS' High-speed LAN Interconnect (HLI) service, an interface-to-interface service that provides easy interconnection of LANs and offers users a choice of Ethernet, Token-Ring, or Fiber Distributed Data Interface.

The MFS Datanet ATM network is managed by the Network Control Center, located in San Jose, California, which uses a Simple Network Management Protocol system to detect network faults.

• **MFS Datanet.** *MFS Datanet Inc.,* 55 S. Market St., #1250, San Jose, CA 95113; 408-975-2200; fax, 408-975-2210.

Circle 953 on reader service card

NEW

Lotus Brings E-Mail to OS/2 2.1

Lotus Development Corp. now offers an easy-to-use, object-oriented version of cc:Mail for the OS/2 Workplace Shell. Its cc:Mail for OS/2 Workplace Shell, Version 1.0, incorporates OS/2 2.1's graphical user interface, providing users with an object-oriented file management system and multitasking capabilities. Users can enjoy the benefits of an e-mail environment without having to switch to their e-mail application.

This advance is due to the Message Template Object (MTO) capability, which allows users to create mail messages directly from the desktop. Using the drag-and-drop feature, objects and files can be copied, deleted, or attached to other documents.

• List price: *cc:Mail for OS/2 Workplace Shell, Version 1.0*, \$495 plus \$345 (10-user), \$845 (25-user), or \$3,295 (100-user). Lotus Development Corp., 55 Cambridge Pkwy., Cambridge, MA 02142; 617-577-8500.

Circle 954 on reader service card



CONVENIENT: cc:Mail for OS/2 Workplace Shell incorporates OS/2 2.1's GUI for ease of use.

NEW

Cabletron Offers Wireless Networking

Cabletron Systems' latest hub offers a cost-effective alternative to wired LANs. The FreeLINK/62 Wireless Ethernet Hub for IEEE 802.3 LANs accommodates up to 62 wireless Cabletron transceivers and incorporates the spread-spectrum technology for signal coverage of up to 20,000 square feet. Devices can be located up to 260 feet away.

The Cabletron approach requires two components: a wireless hub and a wireless transceiver. The FreeLINK/62 provides connectivity to the network through either multiport FLIU-8 or single-port FLIU-1 transceivers.

• List price: *Cabletron FreeLINK/62 Wireless Ethernet Hub*, \$7,972; *FLIU-8*, \$1,899; *FLIU-1*, \$1,899. Cabletron Systems, 35 Industrial Way, Rochester, NH 03867-5005; 603-332-9400; fax, 603-337-2211.

Circle 955 on reader service card

NEW

ODS Adds FDDI-over-UTP Capabilities to Infinity Hub

Optical Data Systems has broadened its existing agreement with Network Peripherals to produce a high-bandwidth networking product at an affordable cost. ODS' new Infinity cards and Desktop Network Interface (DNI) cards can be incorporated into the ODS Infinity hub, allowing FDDI to run over unshielded twisted-pair (UTP) wire.

The Infinity interface card, 1094-UTP, takes up one slot in the hub and is available in a six-port RJ-45 configuration. The DNI cards, manufactured by Network Peripherals, are available in multiple bus types, including 1AT, Micro Channel, and SBus. The cards conform to the current ANSI draft for FDDI over UTP, ensuring greater interoperability between FDDI and UTP products.

• List price: *1094-UTP*, \$5,640; *Desktop Network Interface cards*, \$1,295. Optical Data Systems, 1101 E. Arapaho Rd., Richardson, TX 75081; 214-234-6400; fax, 214-234-1467. Network Peripherals, 1371 McCarthy Blvd., Milpitas, CA 95035; 800-674-8855.

Circle 956 on reader service card

BRIEFS

BACKUP

Colorado Memory Systems has made data protection more affordable by reducing prices on two of its popular tape backup drives. Jumbo 120 is now available for only \$169 and Jumbo 250 is \$199, down from its original price of \$279. Trakker 250, a leading parallel port drive, lists for \$399, a reduction of \$149. The reductions are part of Colorado's commitment to provide low-cost tape backup drives for PCs. 303-669-8000; fax, 303-667-0921.

Legato Systems has announced that its Legato NetWorker (\$2,000 to \$20,000, depending on server configuration) is the first third-party backup and recovery software product to support Solaris, Version 2.1. NetWorker for Solaris, Version 2.1, will offer compatibility and interoperability with other NetWorker backup software platforms for NetWare, Versions 4.0 and 3.11, IBM RISC System/6000, and OEM-licensed products from Data General, Digital Equipment, Intergraph, Sequent, and Silicon Graphics. 415-329-7880; fax, 415-329-8898.

Systems Enhancement Corp. is shipping its new Total Network Recall tape backup and restore software for NetWare networks. Total Network Recall for NetWare 4.0 supports all of Novell's SMS services, including System Independent Data Format. The software runs as a NetWare Loadable Module. Total Network Recall provides support for all data and NetWare files, as well as bindery, security, and name-space information. Available now, the software starts at \$349 for 1 to 10 users, \$499 for 11 to 50 users, and \$799 for 50 and 1,000 users. 314-532-2855; fax, 314-537-2791.

NEW

Lannet Introduces the First Multimedia Hub

Lannet Data Communications is now shipping a cost-effective 10BaseT hub system designed for multimedia applications. The LANswitch system combines one or more of Lannet's fault-tolerant LET-36 or LET-10 hubs (which feature the cell-switching 1.28-gigabyte backplane) with the new 10BaseTV Ethernet 4-, 5-, and 8-port modules, which include application-specific integrated circuit (ASIC) chips for dynamic switching, allowing for virtual networking.

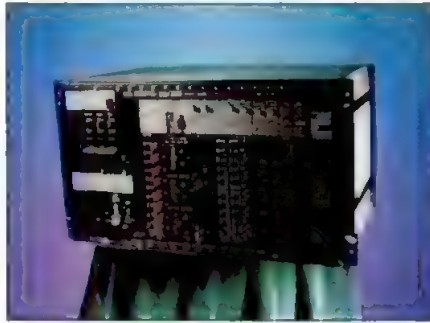
The combination of the hub and 10BaseTV module allows the LANswitch system to run high-bandwidth applications such as digital video, videoconferencing, networked animation, and networked CAD. The modules provide a scalable upgrade path for increased bandwidth in the hub.

Some 10BaseTV modules supporting 10BaseT are available now, and more will be available in the first quarter of 1994. Support for 10Base2 and 10BaseF will follow in the first half of next year.

Network managers can manage the LANswitch hub in a multivendor environment through their native management platform using MultiMan/OV, MultiMan/SNM, MultiMan/6000, or MultiMan/WIN.

- List price: Lannet LSE-108, 1.25 Mbps per user 10BaseTV module/10BaseT, \$1,995; Lannet LSE-208, 2.5 Mbps per user 10BaseTV module/10BaseT, \$2,995; Lannet LSE-808, 10 Mbps per user 10BaseTV module/10BaseT, \$5,995; Lannet LSE-505, 10 Mbps per user 10BaseTV module/10BaseT, price to be announced; Lannet LSE-404, 10 Mbps per user 10BaseTV module/10BaseT, price to be announced. Lannet Data Communications Inc., 7711 Center Ave., #600, Huntington Beach, CA 92647; 714-891-5580; fax, 714-891-7788.

Circle 957 on reader service card



HUB TV: 10BaseTV modules accommodate high-bandwidth applications.

IMPROVED

Shiva's TunnelTalk Links AppleTalk over TCP/IP

K-Star, Version 9.2, Shiva Corp.'s upgrade to its FastPath 5 gateway, makes FastPath the first product to implement IP tunneling based on the new Dr. Pepper specification for linking AppleTalk networks over TCP/IP. FastPath 5 is a LocalTalk-to-Ethernet gateway that routes AppleTalk Phase 1 and 2, TCP/IP, DECnet, and IPTalk. The Version 9.2 upgrade kit adds TunnelTalk (Shiva's implementation of the Dr. Pepper standard) to the list.

Additional features ease the burden of network management. The inclusion of zone filtering allows network managers to determine or limit which zones are available to LocalTalk users. Likewise, device filtering allows managers to determine the availability of devices on the network. Other enhancements include an SNMP community table, a UDP time server, syslogging, log message filtering, and improved DECnet management.

- List price: K-Star, Version 9.2 Upgrade Path for the FastPath 5 and FastPath 5R, \$199. Shiva Corp., Northwest Park, 63 Third Ave., Burlington, MA 01803; 800-458-3550, 617-270-8500; fax, 617-270-8852.

Circle 958 on reader service card

BRIEFS

HUBS

Combinet and **Network Express** provide network managers with affordable high-speed communication between an enterprise LAN and remote sites over ISDN or Switched 56 telephone lines. Combinet's Everywhere family of bridges (\$1,690 to \$2,490) and NE's InterHub (\$9,600 to \$22,200) allow remote users to become part of an enterprise LAN without the expense of leased lines. Combinet, 408-522-9020; Network Express, 313-761-5005.

Bytex Corp. announces new Ethernet switches that segment network traffic inexpensively. The Series 7700 Card Switched Ethernet (\$1,595 to \$1,895) and Port Switched Ethernet (\$1,700 to \$2,700) modules will be available in the fourth quarter of 1993 and the first quarter of 1994, respectively. 508-366-8000.

Optical Data Systems plans to incorporate Artel Communications Corp.'s StarBridge Turbo technology into its Infinity Intelligent Switching Hub. Starting at \$7,200, the improved hub will provide an additional eight connections and throughput up to 80 Mbps. 214-234-6400.

Acsys has cut the cost of per-port switching by reducing prices across the board for the modules designed for Acsys' Paragon family of intelligent networking system hubs. The 12-port 10BaseT module has been reduced from \$2,195 to \$1,495, and the Token-Ring twisted-pair module has been reduced from \$2,495 to \$1,995. 800-462-2797.

Digital Equipment Corp. announced the DEChub 900 MultiSwitch (\$3,990), an eight-slot hub that provides "plug-and-play" installation and support for multiple network services, including ATM. 800-368-6533.

The competition claims to be ahead
by leaps and bounds.

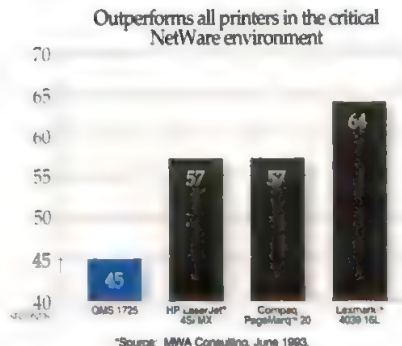


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IMPROVED

Intel Makes Good on Its Smart Network Services Strategy

Intel Corp. now offers a higher level of network control with the implementation of its Smart Network Services (SNS) strategy. The objective of the SNS strategy is to provide more efficient and manageable products. Intel has focused on three areas: smart adapters, smart servers, and smart management.



GETTING SMARTER: EtherExpress Flash 32 LAN adapter includes plug-and-play installation.

So, what makes such smartness advantageous? The EtherExpress Flash32 LAN Adapter, an auto-configurable 32-bit card, features FlashStart for one-step configuration and installation. Enhancements to the StorageExpress ELD, XLD, and XLE smart backup servers include plug-and-play installation and centralized management. The servers support the SNS strategy by integrating with LANdesk Manager, Version 1.5, which addresses the third area of the SNS approach: centralized management and control of NetWare 3.11 environments.

environments.

• List price: *EtherExpress Flash32 LAN adapter*, \$349; *StorageExpress ELD, Version 1.2*, \$7,495; *StorageExpress XLD, Version 1.2*, \$9,995; *StorageExpress XLE, Version 1.2*, \$13,495; *LANdesk Manager, Version 1.5*, \$1,495 per server. Intel Corp., 2200 Mission College Blvd., P.O. Box 58119, Santa Clara, CA 95052-8119; 800-538-3373.

Circle 959 on reader service card

NEW

Cabletron Offers Single-Mode Fiber-optic Connectivity

Cabletron Systems' FDMIM-30 provides full bridging and management functions using single-mode fiber-optic cable functioning as a full-bandwidth Ethernet-to-FDDI bridge and a Fiber Distributed Data Interface (FDDI) management module. It attaches to a FDDI ring as a dual-attached station at distances up to 40 kilometers with other single-mode fiber-optic devices. In its management capacity, FDMIM-30 provides Simple Network Management Protocol and Station Management (ST) management for any FDMIM concentrator modules within the Multi Media Access Center (MMAC) in the intelligent wiring hub.

• List price: *Cabletron FDMIM-30*, \$16,950. Cabletron Systems Inc., 35 Industrial Way, Rochester, NH 03867-5005; 603-332-9400; fax, 603-337-2211.

Circle 960 on reader service card

NEW

IBM Develops High-speed Networking Strategy

IBM reaffirmed its commitment to high-speed networking with plans to develop products using asynchronous transfer mode (ATM) technology. IBM plans to introduce its ATM products, including adapter cards and an intelligent hub, early next year. ATM is a set of international standards for sending large amounts of data, voice, and video information simultaneously over a single network using extremely high transmission speeds.

• IBM Corp., 1133 Westchester Ave., White Plains, NY 10604; 800-426-3346.

Circle 961 on reader service card

BRIEFS

ROUTERS

Retix is shipping a new version of software for its RouterXchange 7000 family of multiprotocol routers. Release 2.1 enhances multivendor interoperability by supporting the Point-to-Point Protocol (PPP), Open Shortest Path First, and RFC 877 for X.25 protocols. The release is now included with all RX 7000 models and is available as a free upgrade to all existing RX 7000 customers. 310-828-3400.

Bytex Corp. (in association with CrossComm Corp.) has designed a family of integrated router modules for its Series 7700 Intelligent Switching Hub. The six Series 7700 XL Router modules are priced between \$10,000 to \$16,000 and can be used with a wide variety of network topologies. The modules provide support for protocol-independent routing for IBM protocols such as SNA and SDLC, as well as protocol-dependent routing for Novell's IPX/SPA and TCP/IP RIP. 508-366-8000.

Zenith Communication Products (a division of Zenith Electronics Corp.) announced X.25 communications support for its Galaxy Exchange, Version 5.04, router. The new module, Model LANBRG-M-X, will cost \$3,000 and provide seven virtual circuits for connection to either public or private X.25 networks. 708-391-8000.

Compatible Systems Corp. makes router management easier with its new Windows-based network management application. Designed for the RISC-Router 3000E, the software will be included with the company's multiprotocol routers and will be available as a free upgrade to present customers. 800-356-0283; 303-444-9532.



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NEW

Banyan Expands SNA Support

Banyan Systems and Digital Communications Associates recently produced an integrated client/server platform that boasts comprehensive Systems Network Architecture (SNA) connectivity. The new Banyan SNA Communications Service allows network managers to function within an IBM host system and its applications within an integrated enterprise network.

• List price: *Banyan SNA Communications Service*, \$2,995. *Banyan Systems Inc.*, 120 Flanders Rd., Westboro, MA 01581; 800-235-5332, 508-898-1000; fax, 508-898-1755. Circle 962 on reader service card

NEW

Synernetics Clears the Path for High-Speed Networking

Synernetics continues its commitment to providing high-speed data communication with the introduction of a new multigigabit client/server switching hub. LANplex 6000 addresses the current needs of network managers for increased bandwidth while at the same time addressing future demands. The switching hub provides intranet-network routing as well as upgrade paths for switched 100-megabit-per-second (Mbps) Fiber Distributed Data Interface (FDDI) and asynchronous transfer mode. ATM, a new high-speed networking technology, is a set of international standards for simultaneous transmission of large amounts of data, video, and voice information. The 12-slot hub, Model 6012, provides servers with 100-Mbps FDDI throughput and switched 10 Mbps Ethernet segments for clients. LANplex 6000 also features built-in Internet Protocol/Routing Information Protocol (IP/RIP) routing capabilities.

• List price: *LANplex 6000 Model 6012*, \$31,900; *8-port 10-Mbps Ethernet add-on modules*, \$12,500; *FDDI concentrator modules*, \$8,500. *Synernetics Inc.* 85 Rangeway Rd., North Billerica, MA 01862; 508-670-9009; fax, 508-670-9015. Circle 963 on reader service card

IMPROVED

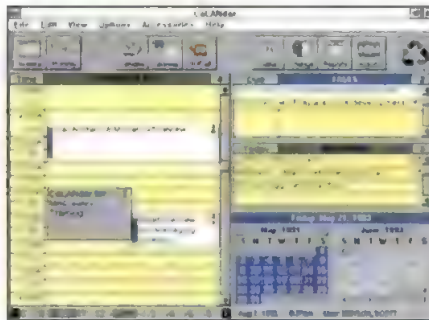
CaLANDar Gets a New Look

Microsystems Software's latest enhancement of its group scheduler for Windows and DOS, CaLANDar, focuses on making it easy to use. Version 2.5 adds new features such as customizable daily, weekly, and monthly screens. The daily and weekly screens provide users with the ability to click and drag to create, modify, and delete appointments. CaLANDar also features a recycle symbol or a trash compactor instead of a trash can for deleted appointments.

CaLANDar's daily screen displays each day's schedule and messages. CaLANDar's weekly screen provides a five-day view, and the program's monthly screen displays the activities of multiple users and/or resources.

• List price: *CaLANDar, Version 2.5*, free to users under warranty, other users can obtain the upgrade for \$4 per user. *Microsystems Software Inc.*, 600 Worcester Rd., Framingham, MA 01701; 508-879-9000; fax, 508-626-8515.

Circle 964 on reader service card



GO GUI: Displays daily planner with message and task boards.

BRIEFS

MODEMS

Telenetics Corp.'s new OZ144 Security Modem can be easily upgraded to the 28.8-Kbps V.fast-class speed. The OZ144 (\$1,445) is the latest in the OZ Guardian modem series. The modem features advanced event logging, remote configuration and management, and trilevel security. OZ144 is compatible with CCITT V.22, V.22bis, V.32, V.32bis, and Bell 212 and 103. 714-455-4000.

Patton Electronics Co. unveiled the Patton Model 1180 (\$425), an RS-232C/V.35 short-range modem. Model 1180 operates over a single fiber with asynchronous data rates of 256 kilobits per second (Kbps) and synchronous data rates of 38.4 Kbps. High-speed rates allow the modem to perform LAN-to-LAN, LAN-to-WAN, and videoconferencing capabilities. 301-975-1000.

NETWORK MANAGEMENT

FTP Software is shipping its new version of LANWatch Network Analyzer: Version 3.1. LANWatch (\$1,200) is the first software-based monitoring product to permit users to monitor Serial Line Internet Protocol (SLIP) or point-to-point traffic on a serial connection. LANWatch, Version 3.1, supports over 60 protocols and features a graphical statistical display and a new summary display mode. 508-685-3300; fax, 508-794-4477.

InterCon Systems Corp.'s newest version of its Network File System client software for the Macintosh provides users with even more connectivity features. NFS/Share, Version 1.3 (\$295 per node) features auto-mounting of multi-platform servers, comprehensive sharing information, and more extensive system compatibility. 703-709-5500; fax, 703-709-5555.

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NEW

Crescendo Introduces Dual-Attach Adapter

Crescendo Communications' newest adapter is the first dual-attach solution to address the needs of Sun SPARC-based servers. The CDDI SBus Dual-attach Adapter supports Fiber Distributed Data Interface (FDDI) over unshielded or shielded twisted-pair wiring. Based on Crescendo's Copper Distributed Data Interface (CDDITM) architecture, the adapter offers connections up to 100 megabits per second in two ways: dual-attach or dual-homed. Network management is accomplished through a Simple Network Management Protocol (SNMP) agent.

• List price: *CDDI SBus Dual-attach Adapter*, \$1,995. Crescendo Communications, 710 Lakeway Dr., Sunnyvale, CA 94086; 800-238-2334, 408-732-4400; fax, 408-732-4604. Circle 965 on reader service card

NEW

Microtest Debuts CD-ROM Networking

Microtest's Discport simplifies the integration of CD-ROM storage into NetWare networks. With Discport, NetWare users are able to share CD-ROM drives without those drives being attached to the file server or to the individual network workstations.

The Discport is a videotape-sized box that can be installed anywhere on a thin Ethernet or 10BaseT LAN NetWare 3.11 or 4.0 network. As many as seven CD-ROM drives can be attached to each Discport, and multiple Discports can be used on the network. Integration with NetWare is seamless (no TSR or redirector software is required on the workstations). Discview, the Windows-based utility included with Discport, provides step-by-step installation help.

• List price: *Discport*, \$695. Microtest Inc., 4747 N. 22nd St., Phoenix, AR 85016-4708; 800-526-9675; 602-957-6400; fax, 602-957-6414.

Circle 966 on reader service card



LUCKY SEVEN: Attaches up to seven CD-ROM drives to NetWare LANs.

NEW

MCS Provides Interoperability Between Unix and NetWare

Micro Computer Systems now offers two new products to promote greater interoperability, compatibility, and transparency between Unix and NetWare operating systems. The UniLink for AIX operating system is designed to help software developers integrate Unix and NetWare networks through Unix/NetWare application programming interfaces (APIs).

The system includes UniLink Basic for AIX and UniLink NetBIOS for AIX. UniLink BASIC provides APIs for Unix and NetWare environments, as well as terminal emulation of Unix hosts from NetWare clients.

UniLink NetBIOS runs over both Ethernet and Token-Ring, adding a NetWare-compliant NetBIOS API to the Unix system. The NetBIOS system supports Network Control Block, Unix Streams TLI, and the XOpen XTI standard interfaces for application program development.

• List price: *UniLink Basic for AIX (24-user)*, \$995; *UniLink NetBIOS for AIX*, 995. Micro Computer Systems Inc., 2300 Valley View Lane, #800, Irving, TX 75062; 214-659-1514; fax, 214-659-1624.

Circle 967 on reader service card

BRIEFS

UPS

Network Security Systems introduced a new line of network power-backup and management solutions for the Novell and Unix environments. NET-UPS (\$549 to \$1,310) products include intelligent uninterruptible power supply (UPS) and LanSafe II power-management software. NET-UPS provides simultaneous management of all network resources and remote control of hardware through LAN or WAN connections. 800-755-7078; 619-587-7950; fax, 619-552-9162.

Deltec Electronics Corp. uses a breakthrough technology to manage the life of batteries in UPSs. Advanced Battery Management reduces the frequency of battery replacement and features three different levels of charging. Deltec incorporates ABM in its new family of UPSs: PowerRite Pro (\$449). 800-854-2658; 619-291-4211.

SECURITY

Reflex added features to and dropped the price of its antivirus product from \$135 per PC to \$95 per PC. Disknet is a proactive Windows or DOS NetWare application that scans disks upon insertion, verifying that all disks are virus-free. Once the disks are verified, Disknet encrypts a signature on the disk, making it usable on attached PCs. Version 2.1 includes a virus audit trail and network modules. 800-673-3539.

Trend Micro Devices' new StationLock LANPack (\$99 per workstation, \$240 per server) features centralized security control for the NetWare environment. StationLock LANPack consists of a NetWare Loadable Module and a boot ROM chip on an adapter within the workstation and provides virus protection, access and recovery control, and encryption capabilities. 310-782-8190.



Rapa Nui men of Easter Island race with heavy loads, commemorating deadly clan rivalries of past times.

NAT's Remote IP Router Makes Routing Bunches of Information Easier.

If your data is competing fiercely for position on the phone line, you're likely to lose a bunch of packets before the race is over. So before you risk your most important data across the WAN, you'd better consult with Network Application Technology.

COMMUNICATIONSWEEK BRIDGE/ROUTER RATING

Average, all devices in test program	54
NAT LANB/290 Remote IP Router/Bridge	70
Vitelink/MSC 6602 bridge-router	69
3Com NetBuilder II bridge-router	66
Newbridge Ethernet Lite Bridge	66
Proton CNX 500 Bridging Router	57
Xyplex 3210 local bridge-router	54
Wellfleet Link Node bridge-router	47
ACC ACS 4200 bridge-router	43
Microcom MBR 6000 bridge-router	35

NAT's LANB/290 Remote IP Router/Bridge is the latest revision to NAT's already acclaimed LANB/280 Remote IP Router/Bridge.

NAT's LANB/290 Remote IP Router provides the most affordable high-performance solution for expanding Internet Protocol networks to remote locations. The LANB/290 passes data between networks more efficiently by routing only necessary traffic over the WAN link.

The LANB/290 routes information easily, even in today's multi-vendor enterprise networks.

It is compatible with Ethernet routers from other vendors—forwarding non-IP packets using the standards-based Point-to-Point Protocol (PPP).

The NAT router supports the latest SNMP standard, so it's compatible with the most advanced management stations (including NAT's own NMS/100). So, you can maximize the potential of your multi-vendor network.

Great features are meaningless if you can't get the router up and running—that's why NAT designed the LANB/290 to be a true plug-and-play device—so installation and operation won't drive you bananas!

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CIRCLE 864 ON READER SERVICE CARD

To Switch or Not to Switch?

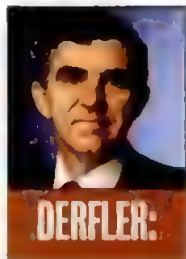
You're wandering all over the network LANscape on this one, David, and I think you're headed for a cliff. If you plant multiple adapter cards in your server and add multiple Ethernet switches as you need them, many seasons will pass before you need to dump your stock of adapters and wiring hubs. Running toward fast networking now will leave you like Wile E. Coyote: churning air with your feet before you fall.

I've always been a big proponent of putting multiple LAN adapters—as many as will fit—into file servers. This configuration allows you to segment your cabling scheme: Each segment and server adapter carries a level load, and certain high-priority nodes get their own channel to the server. NetWare has always been kind to processors, so the argument that adding more adapters increases server CPU loading is just so much noise. It also doesn't matter. As symmetrical multiprocessing servers hit their stride under Windows NT and some flavors of Unix later this year, monster servers will contain a lot more I/O capability than even a stack of adapters can exhaust.

Dave, as far as the 100-megabit-per-second stuff goes (and it *won't* go far in most existing cable installations), I'm skeptical about the real gain in throughput. Adding a lot of adapters to a fast shared pipe—the likely scenario—makes it a slow shared pipe. I expect to be vigorously lobbied by folks from Hewlett-Packard, AT&T, and other supporters of fast networking, but I'm going to be hard to convince.

I especially don't care for the 100Base/VG standard those companies are pushing. Shoving data down wire pairs in parallel paths is so inelegant it makes me shudder. So much can go wrong in that architecture. Fast Ethernet over good cabling is a much nicer plan, but it will break down under the video and audio data from multimedia and workgroup applications.

I think Ungermann-Bass has it right, David. The DragonSwitch is a high-performance Ethernet switch. Representing the second step in configuring for high throughput (the first step is segmenting with multiple server adapters), it and similar products make a lot of sense. U-B's Eagle-Switch is a 2-Gb-per-second ATM product that will include interfaces to Ethernet, Token-Ring, FDDI, and serial connections. Migration from multiple adapters through Ethernet switching to ATM is the smart plan.



Adding a lot of adapters, the likely scenario, to a fast shared pipe makes it a slow shared pipe.



File servers need more bandwidth than clients, but providing that bandwidth with just a switch is often impossible.

I've said it before, Frank: Switches *used* to be a great way to migrate the customer to faster networks. But with FDDI over copper and the other new networking alternatives, the time to switch has long passed.

When Kalpana introduced the Etherswitch, switching looked like a great idea. Just take an Ethernet LAN, swap the hub for a switch, and presto: You get faster packets. There are no cable or adapter changes. The performance boost comes from locating fewer stations on each segment: There's more bandwidth to go around. Instead of sharing 10Mb among 15 stations, you end up sharing 150Mb among 15 stations.

Another benefit is dynamic reconfiguration. We've all heard that ATM will redefine how we share information: You'll be able to establish ad hoc networks. Have an important project that requires sharing lots of information? No problem. You'll be able

to establish a workgroup through software dynamically. There are no cables to reconnect. Ethernet or Token-Ring switches can give you the same functionality today, and you don't need expensive fiber. You can run these new networks off of your existing cabling plant.

Investment protection is the motto here. But it means more than watching over what you have installed; it also means building an infrastructure that scales to handle tomorrow's speeds.

Switched Ethernet simply can't meet those needs. File servers commonly need more bandwidth than clients. Yet providing servers more bandwidth with just a switch is often impossible. Think about it. If you have 15 stations requesting access to a file server, and all the stations use just 10 percent of their 10-megabit pipes, the connection to the file server will inevitably be bottlenecked. You can add more network connections to your file server, but that eats up more CPU cycles.

Despite some recent moves by leading hub vendors, switches are still largely sold as discrete boxes. Because they aren't integrated into a cabling architecture, they remain more difficult than wiring hubs to implement and install.

Frank, I say the solution is clear: We need hybrid switches, preferably integrated into the wiring hub. They would let you run Ethernet to the desktop and FDDI or some other higher-speed medium to the server. Placing servers on the FDDI ring would put performance where it's most needed: at the server. And that is an idea worth switching to, Frank.

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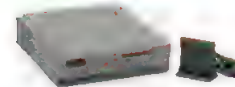
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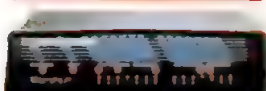
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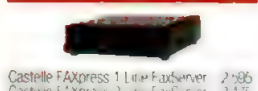
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• 64K RAM Cache

• 16 Bit Ethernet Adapter

• 80MB HD

• Choice of 1.2 or 1.44MB FDD

• 28MM SVGA Color Monitor

• 1MB SVGA Adapter

• Desktop or Mini Tower Case

• 101 Enhanced Keyboard

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• 64K RAM Cache

• 16 Bit Ethernet Adapter

• 130MB HD

• Choice of 1.2 or 1.44MB FDD

• 28MM SVGA Color Monitor

• Desktop or Mini Tower Case

• 101 Enhanced Keyboard

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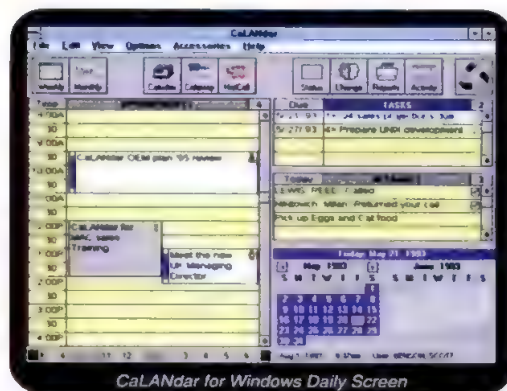
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Dots and Double Dots

Turning Off a Dialog Box

BY NEIL J. RUBENKING

DOTS AND DOUBLE DOTS

Every subdirectory contains two special entries: a single dot (.) and a double dot (..). The purpose of the double dot is clear—you can use it to change to the parent of any subdirectory. But as far as DOS itself is concerned, the purpose of the single dot, which refers to the subdirectory itself, is less clear. Yes, it can replace *.*; for example, DEL . is equivalent to DEL *.* and easier to type. But what does DOS use it for?

It seems that the single dot entry is used by CHKDSK to determine if a subdirectory is valid. That is, when CHKDSK sees a directory entry that is a subdirectory, it looks at the starting cluster pointed to by that entry to make sure that its first entry is the single dot, and that this entry points to the cluster that contains it. If either test fails, CHKDSK reports the subdirectory as invalid. The same applies to the double dot entry. But these two directory entries are apparently never used by other DOS commands such as DIR, COPY, XCOPY, and CD. With these commands, DOS's internal tables are used to determine the actual locations of the current directory and its parent.

I learned about this by experimenting. First I created a subdirectory called TEST on a floppy disk in my A: drive. Then I used a low-level disk editor in the subdirectory to change the single dot entry to FOO. This resulted in a kind of loop. From A:\TEST, typing CD FOO would bring me to the nonexistent directory A:\TEST\FOO, which naturally showed the same contents as TEST. Typing CD FOO again moved me to A:\TEST\FOO\FOO, and so on. However, issuing the command CD . in one of these spurious directories didn't cause any er-

rors, nor did it change the current directory. Clearly CD does not actually look at the single dot entry.

From the directory A:\TEST\FOO\FOO\FOO, repeating the command CD .. stepped you back toward the root directory one level at a time. Obviously, CD doesn't use the double dot directory entry, or CD .. would have gone directly to the root directory.

For further testing, I changed the double dot entry to BAR. From A:\TEST, CD BAR goes to the nonexistent directory A:\TEST\BAR, which displays the same contents as the root directory. CD TEST brought me to A:\TEST\BAR\TEST, and CD BAR again landed in A:\TEST\BAR\TEST\BAR. As before, CD .. moved back toward the root directory one level at a time, proving that the CD command doesn't use the double dot entry. Run on the modified disk, CHKDSK warns that the directory TEST is invalid and offers to convert it to a file.

For a final test, I used the disk editor to change the starting cluster in the dot and double dot entries, without renaming them. Again CHKDSK reported TEST as an invalid subdirectory, but it was able to restore the correct cluster numbers to the dot and double dot entries. Similar tests showed that the COPY and XCOPY commands and the CHDIR function in a BASIC program all work properly when referencing the dot and double dot

entries, even when they've been renamed with a disk editor.

*Gregory A. Wolking
Orlando, Florida*

► **PC MAGAZINE:** What a masterpiece of investigation! I haven't seen this behavior documented anywhere, and I wouldn't have guessed that the dot and double dot entries aren't used by most DOS commands. It's not clear just where those commands do get the name of the current directory and its parent, but the most likely source is the undocumented Current Directory Structure (CDS). This is an internal DOS structure, an array with one entry for each possible drive letter up to the letter specified in the LAST-DRIVE= line in CONFIG.SYS. Among other things, each CDS entry contains the full pathname for the current directory on the corresponding drive.

It's interesting to note that the SUBST command uses the CDS to accomplish its magic. SUBST can assign an otherwise unused drive letter to a particular subdirectory. For example, the command

SUBST I: C:\UTILS

lets you refer to the C:\UTILS subdirectory as drive I:. If the current directory on drive I: is I:\BATCH, the CDS entry for drive I: will contain the pathname C:\UTILS\BATCH. Other fields of the CDS identify this as a SUBST drive and indicate that the C:\UTILS portion corresponds to the root directory of this SUBST drive.

TURNING OFF A DIALOG BOX

I use a screen saver in Windows that is password-protected. It works fine except that if someone bumps the mouse, the

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password dialog box comes on and stays on until someone cancels it or enters the password. That's pretty clunky—the dialog box should just turn itself off after so much time, letting the screen saver get back to work. I decided to write a script to turn off the dialog box using ScriptTools, the PC Tools for Windows (PCTWin) scripting program. Here's how I did it.

From the Windows control panel, I set the timer so that the screen saver would appear after 1 minute of idle time. Next I used ScriptTools to start recording the Windows session. I did nothing further until the screen saver came on. At that point, I bumped the mouse, which made the password dialog box come on, then I canceled the dialog box by hitting the Esc key. I bumped the mouse again, but this time I entered my password when the dialog box appeared.

Next I clicked on the ScriptTools icon and stopped recording the Windows session. I saved the recorded session, which gave me the name of the dialog box that comes up when this particular screen saver is on. Note that I use the Forest screen saver supplied with PCTWin. If you use a different screen saver, you'll get a different name for the password dialog box window. The recording also gave me the exact commands needed to cancel the dialog box.

The script is shown in Figure 1. The first thing I did was define the activation

CLOSPASS.SCT

Complete Listing

```
; To create the saver name, start with the file name
; of the *.SCR file. Add an underscore, followed by
; the title of the dialog box that comes up when you're
; supposed to enter your password.
SaverName$ = "CPFOREST_CPS Forest"

Define Window Event OpenScreenBox
    Activate
    In Window SaverName$
EndDef

Whenever OpenScreenBox
    Pause 10
    If WindowExists( SaverName$ ) = 1
    Then
        Attach SaverName$
        WK_CANCEL = 2
        Button WK_CANCEL SingleClick
    EndIf
EndWhen
Suspend
```

Figure 1: This PC Tools for Windows script automatically closes the password dialog box for a particular screen saver if you don't respond within 10 seconds.

TEST.SCT

Complete Listing

```
; Use the "SSMARQUE_WindowsScreenSaverClass1" parent window
Attach "SSMARQUE_WindowsScreenSaverClass1", 1
    Move To 0 (0)    Size To 640 (480)

; Use the "SSMARQUE_Marquee" dialog window
Attach "SSMARQUE_Marquee", 1
    Wk_Cancel = 2
    Button Wk_Cancel SingleClick

; Use the "SSMARQUE_Marquee" dialog window
Attach "SSMARQUE_Marquee", 1
    Wk_password = 10
    EditText Wk_password "password"
    Wk_OK = 1
    Button Wk_OK SingleClick
```

Figure 2: This recorded Windows session reveals that the name to use for the Marquee screen saver is SSMARQUE_Marquee.

of the named password dialog box window as an event. Whenever that event occurs, the script pauses for 10 seconds, then checks to see if the window is still there. If you enter your password during the pause, of course you close the dialog box yourself. If you don't enter your password—as when someone accidentally hits a key or the mouse—the script cancels the dialog box.

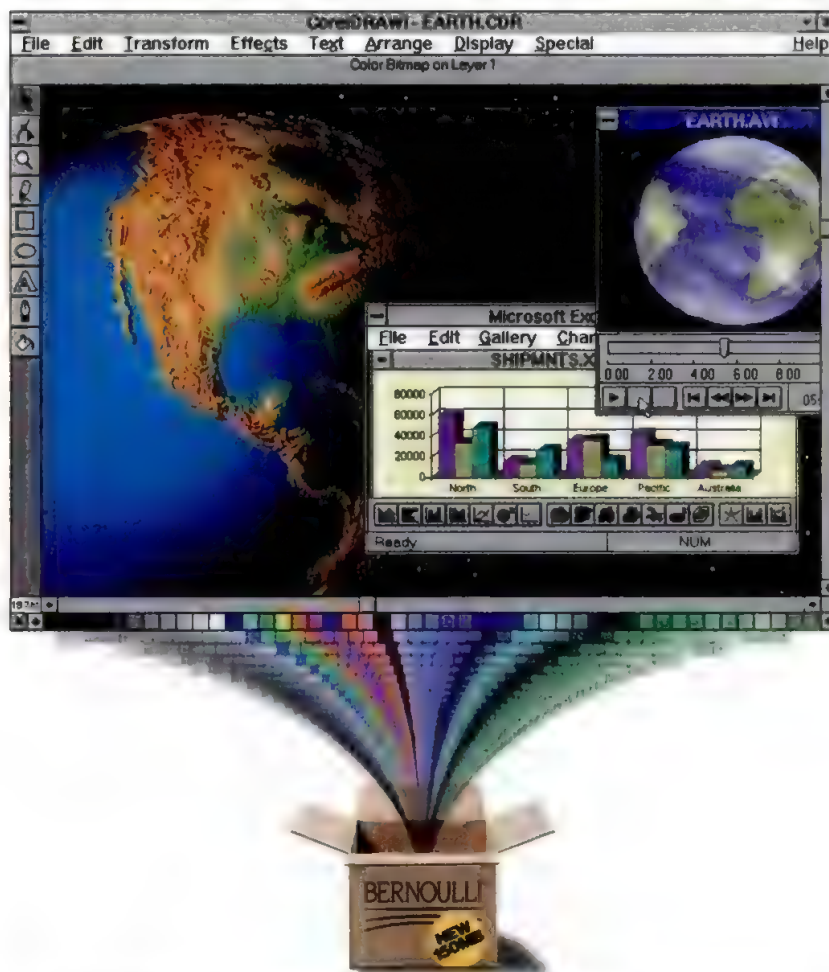
I dragged the icon for the compiled .RUN version of the script into my Startup folder so that it runs automatically. It turns off the unwanted dialog box after 10 seconds, nice as you please.

*Bob Lear
Vernon, California*

► **PC MAGAZINE:** Figure 2 is an example of the recorded script that results from following Mr. Lear's approach. In this case, though, the screen saver is the standard Windows Marquee.

I modified the original CLOSPASS .SCT to define the screen saver name as a variable, so you only have to change it in one place if you switch screen savers. You can follow the above technique to get the correct name to use for your current screen saver, but observation reveals another way to figure out that name. The portion of the name before the underscore is the filename of the .SCR file containing the screen saver. If you're not sure what that filename is, look in the [boot] section of SYSTEM.INI for the key SCRNSAVE.EXE=. The value of this key is the full pathname for the current screen saver.

The part of the name after the underscore is the name of the dialog box that asks you for your password. To view that dialog box, just click the Test button in Control Panel's Desktop module and then move the mouse. This name is *not* always the same as that of the screen saver itself. For example, using the standard screen saver Flying Windows, the title of the password dialog is Flying Window, singular. The .SCR file for this screen saver is SSFLYWIN.SCR, so you'd set the variable SaverName\$ to SSFLYWIN_Flying Window. Remember that you must recompile the script after this change. You can download both of these scripts from PC Magazine's Utilities/Tips Forum, archived as CLOSPA.ZIP. □



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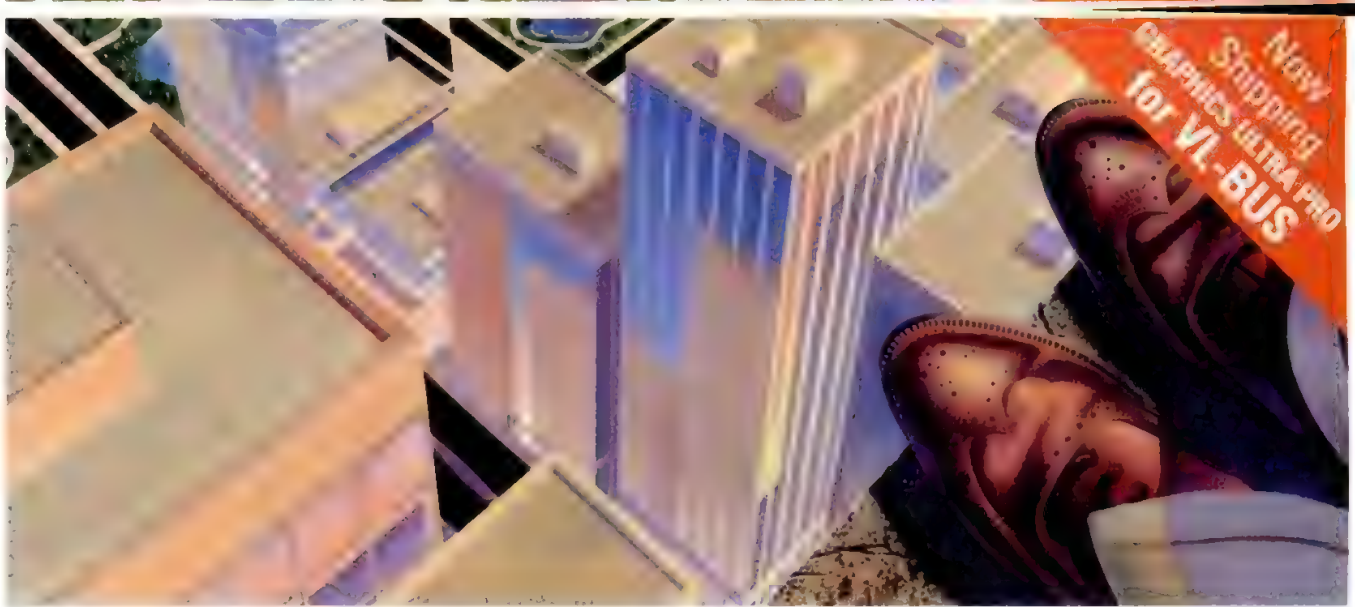
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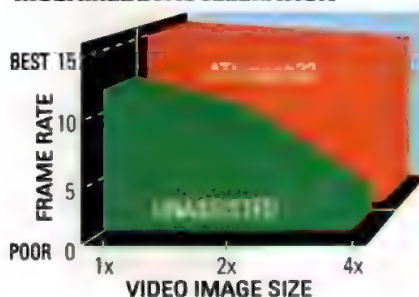
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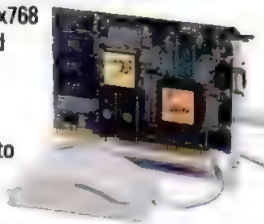
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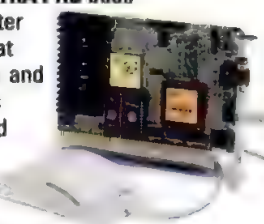
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Writing DOS Utilities With DEBUG, Part 2

BY JEFF PROSISE

Last issue, we began a multipart series on using DEBUG to write small assembly language DOS utilities. We learned a few elementary assembly language instructions and briefly surveyed a few of the hundreds of programming services available in DOS and in the BIOS.

Among the instructions we learned how to use were MOV, which moves data to a register or memory location, and INT, which executes a software interrupt (similar to calling a subroutine, but in this case the subroutine is stored in DOS or in your PC's ROM BIOS). We used two DOS services—interrupt 16h, function 00h (which retrieves a key code from the keyboard) and interrupt 21h, function 4Ch (which terminates a program and returns an exit code to the calling program or batch file)—to write a short utility that waits until a key is pressed and then returns a code identifying the key.

In Part 2 of this series, we'll look at three DOS programming services available through interrupt 21h: DOS function 2Ah, which returns the current date; DOS function 2Ch, which returns the current time; and DOS function 30h, which returns the DOS version number. These are but three of the dozens of programming services that DOS provides, but they are particularly useful for writing short utilities to enhance batch file operation. As you learn about these DOS services, you'll also learn some additional and very useful assembly language instructions.

CHECKING THE DOS VERSION NUMBER

It's not at all unusual to write a batch file or DEBUG utility that relies on version-specific aspects of DOS. For example, one common method for determining whether ANSI.SYS is installed requires DOS 4.0 or later. If you write a batch file

that uses ANSI.SYS escape sequences to paint the screen or program the keyboard, you should have the batch file verify that ANSI.SYS is installed before proceeding. Another example: Some batch files use the CALL command to load and execute other batch files. However, the CALL command didn't appear until DOS 3.3, so CALL commands produce "Bad command or file name" messages in earlier versions. If a batch file is aware

*Build on your assembly
language skills to construct
utilities that report the
DOS version, the time,
and the date, and
learn about jump and
arithmetic instructions.*

that it's running under DOS 3.2 or earlier, it can usually use COMMAND /C in lieu of CALL. But first it needs a means for determining what version of DOS it's running under.

That's where DOS function 30h can help. Function 30h, which is invoked by placing a 30h in register AH and executing an INT 21h instruction, returns two

pieces of information: a major version number in AL (the 3 in DOS 3.20, for example) and a minor version number in AH (the 20 in DOS 3.20). For reference purposes, function 30h is summarized in Figure 1. In DEBUG, the assembly language instructions

```
MOV AH, 30
INT 21
CMP AL, 3
JB 0180
```

branch to the instruction at offset 0180h if the major version number is less than 3. (Remember that DEBUG always thinks in hex, so you don't have to enter the h after hexadecimal numbers; doing so, in fact, will generate an error message from DEBUG.)

CMP (which is short for *compare*) is the assembly language instruction to compare one number to another. The instruction CMP AL,3 compares the value in register AL (which holds the major version number after a call to DOS function 30h) to 3. Then the instruction JB 0180 jumps to 0180h if the value in AL is less than 3.

JB stands for Jump if Below. To programmers, JB is known as a *conditional jump* instruction. Figure 2 lists some of the other conditional jump instructions that your CPU supports. JE (or JZ), for example, jumps if and only if the values compared with a CMP instruction are

DOS Function 30h

Function number:	30h
Function name:	Get DOS Version Number
Description:	Returns the DOS version number in AH and AL
Call with:	AH = 30h
Returns:	AL = major version number (for example, the 3 in DOS 3.20) AH = minor version number (for example, the 20 in DOS 3.20)

Figure 1: This DOS function returns the current DOS version.

Conditional Jump Instructions

Instruction	Stands for...	Description
JB (or JNAE)	Jump if Below (Jump if Not Above or Equal)	Jumps if x is less than y after a CMP x,y instruction
JE (or JZ)	Jump if Equal (Jump on Zero)	Jumps if x is equal to y after a CMP x,y instruction
JA (or JNBE)	Jump if Above (Jump if Not Below or Equal)	Jumps if x is greater than y after a CMP x,y instruction
JBE (or JNA)	Jump if Below or Equal (Jump if Not Above)	Jumps if x is less than or equal to y after a CMP x,y instruction
JAE (or JNB)	Jump if Above or Equal (Jump if Not Below)	Jumps if x is greater than or equal to y after a CMP x,y instruction
JNE (or JNZ)	Jump if Not Equal (Jump on Not Zero)	Jumps if x is not equal to y after a CMP x,y instruction

Figure 2: These jump instructions are used in conjunction with the CMP instruction to provide conditional branching in assembly language. The names in bold are the ones returned by DEBUG if you unassemble a program with its U command.

equal, while JA (or JNBE) jumps if the value to the left of the comma in a CMP instruction is greater than the value on the right. It's easy to see why JA and JNBE are equivalent, but what about JE and JZ? JZ stands for Jump on Zero. When two values compared with a CMP instruction are equal, CMP sets the Z (zero) flag—one of the bit-sized flags in the microprocessor's FLAGS register. JZ tells the program to jump if the Z flag is set. In truth there is no JE instruction; DEBUG codes it up as JZ. DEBUG lets you enter JE, if you wish, because *Jump if Equal* is a more intuitive way to think about the results of a comparison than *Jump on Zero*. Combined with the CMP instruction, these conditional jumps make it easy to compare a value in a register to a known value and then to branch according to the outcome. We won't use conditional jumps in any of this issue's DEBUG scripts, but we will use them at a later date. So file this information away in your head for future reference.

Function 30h makes it easy to write a utility that reports the DOS version number to a batch file. Here's the complete DEBUG script for a utility named GETVER.COM, which returns the major version number as an exit code. (Start DEBUG before typing in these commands. As an alternative, you may enter the commands in a text file and execute them off-line by typing

```
DEBUG < filename
```

where *filename* is the name of the text file.)

```
A 100
MOV AH, 30
INT 21
MOV AH, 4C
INT 21

N GETVER.COM
RCX
8
W
Q
```

GETVER calls DOS function 30h to get the major version number in AL. Then it invokes DOS function 4Ch to terminate itself. Recall from the last issue that when function 4Ch is invoked, the value in AL is returned as the exit code. Therefore the batch file

```
GETVER
IF ERRORLEVEL 4 GOTO END
ECHO Error: Requires DOS 4.0 or higher
:END
```

will run silently if the DOS version is 4.0 or higher, but it will display the message "Error: Requires DOS 4.0 or higher" if it's run under an earlier version.

It's equally easy to write a DEBUG utility that returns the minor DOS version number: Just modify the script for GETVER.COM so that it copies the value in AH to AL, with the line MOV

AL, AH right after the first INT 21 line, and change the 8 following the RCX statement to A to reflect the program's increased length.

However, if the minor version number is of concern, it would be more convenient to build GETVER.COM so that it returns a single value that reflects both the major and minor version numbers. One obvious solution would be to multiply the major version number by 100 and add the minor version number so that DOS 3.20, for example, would return 320. But exit codes can't be higher than 255, so that won't work.

A reasonable alternative is to multiply the major version by 10, divide the minor version by 10, and add the results together. If it were run under DOS 3.20, GETVER would then return 32. You lose the hundredths portion of the version number (the 0 in 3.20), but that's usually unimportant. If it is important, you can always check it separately with a COM file that returns only the minor version number, as described above.

The following DEBUG script creates GETVER2.COM, which consolidates the major and minor version numbers into a single value. (DOS 3.20 would be reported as 32, while DOS 6.0, for example, would be reported as 60.)

```
A 100
MOV AH, 30
INT 21
MOV DH, AH
MOV BL, 10
MUL BL
MOV DL, AL
MOV AL, DH
DIV BL
ADD AL, DL
MOV AH, 4C
INT 21

N GETVER2.COM
RCX
16
W
Q
```

GETVER2.COM introduces three new assembly language instructions: MUL, DIV, and ADD. The instruction MUL BL multiplies the byte value in AL by the byte value in BL, leaving the result

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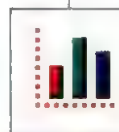
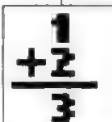


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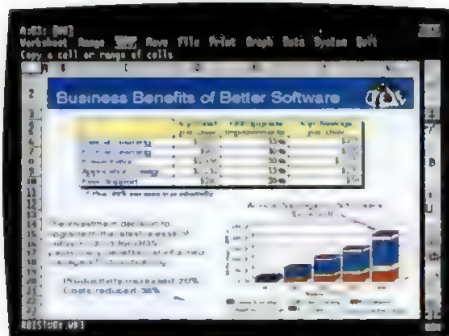


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Working Together

DOS Functions 2Ah and 2Ch

Function number:	2Ah
Function name:	Get Current Date
Description:	Returns values revealing the year, month, day, and day of the week
Call with:	AH = 2Ah
Returns:	CX = year (1980 through 2099) DH = month (1 through 12, where 1=January, 2=February, and so on) DL = day of the month (1 through 31) AL = day of the week (0 through 6, where 0=Sunday, 1=Monday, 2=Tuesday, and so on)
Function number:	2Ch
Function name:	Get Current Time
Description:	Returns the current time
Call with:	AH = 2Ch
Returns:	CH = hour (0 through 23) CL = minutes after the hour (0 through 59) DH = seconds (0 through 59) DL = hundredths of seconds (0 through 99)

Figure 3: These DOS functions are used in assembly programs to get the current date and time. **NOTE:** You should not rely on the value returned in DL for accurate timing. The PC's internal clock lacks sufficient resolution for timing events to the hundredth of a second.

in register AX. The product of two byte values sometimes exceeds 255 (the highest value that a byte can hold). That's why the result is stored in a word-sized (2-byte) register. Similarly, the instruction `DIV BL` divides the word value in AX by the byte value in BL, leaving the quotient in AL and the remainder in AH. If AX holds 20 (the minor version number returned for DOS 3.20), this `DIV` instruction will leave 2 in AL and 0 in AH. Finally, the `ADD` instruction adds two values together, depositing the result in the register or memory location on the left side of the comma. The instruction `ADD AL, DL` adds the byte-sized value in DL to the value in AL.

Now back to `GETVER2.COM`. After the major and minor version numbers are obtained by calling function 30h, the instruction `MOV DH, AH` transfers the minor version number to the DH register, which serves as a temporary storage location. Next, the instructions

```
MOV BL, 10
MUL BL
MOV DL, AL
```

multiply the major version number in AL by 10 and transfer the low byte of the re-

sult to DL for temporary storage. We're only concerned with the low byte, because the major version number times 10 should never exceed 255. (Unless, that is, DOS someday makes it to version 26.0!) Then the instructions

```
MOV AL, DH
DIV BL
ADD AL, DL
```

move the minor version number back into AL, divide AX by 10 (the high byte of AX is already set to 0 as a result of the multiply operation, and BL still holds the 10 we loaded into it before the multiply), and add the value saved in DL

```
MOV AH, 4C
INT 21
```

terminate the program and return the exit code in AL.

Now, the batch file

```
GETVER
IF ERRORLEVEL 33 GOTO END
ECHO Error: Requires DOS 3.3 or higher
:END
```

will inform the user that DOS 3.3 or higher is required if it is run under an earlier version of DOS.

GETTING THE DATE AND TIME It's equally easy to write a short utility that returns the current hour of the day as an `ERRORLEVEL` value, or for that matter to write a utility that returns a code that identifies today's date or the day of the week (Monday, Tuesday, Wednesday, and so on). All this information is readily available from DOS. The key: functions 2Ah and 2Ch, which are summarized in Figure 3.

Suppose you'd like to write a batch file that performs a full optimization on drives C:, D:, and E: with DOS 6.0's `DEFRAG` command, but that you'd like the first `DEFRAG` command to be executed at 2:00 A.M. Here's what such a batch file might look like:

```
:START
GETHOUR
IF NOT ERRORLEVEL 2 GOTO START
IF ERRORLEVEL 3 GOTO START
DEFRAG C: /F
DEFRAG D: /F
DEFRAG E: /F
```

This looks straightforward enough. But DOS doesn't provide a `GETHOUR` command, so you'll have to concoct one for yourself. The following `DEBUG` script will create `GETHOUR.COM`, which returns an exit code equal to the current hour of the day:

```
A 100
MOV AH, 2C
INT 21
MOV AL, CH
MOV AH, 4C
INT 21

NGETHOUR.COM
RCX
A
W
Q
```

Now that you're beginning to get a grasp of things, it's not too hard to figure out how `GETHOUR` works. It obtains the current time by calling DOS function 2Ch. Then it transfers the value in CH, which represents the current hour of the day, to AL, and terminates using DOS function 4Ch. We could just as easily have built `GETHOUR` to return the number of minutes after the hour by replacing the lines `MOV AL, CH` with `MOV AL, CL` and changing `NGETHOUR.COM` to, let's say, `GETMIN.COM`. By modifying the batch file so that it calls both `GETHOUR` and `GETMIN`, you could then execute `DEFRAG` at a more precise time—say, 2:30 A.M.

Suppose instead that you wanted to modify your `AUTOEXEC.BAT` file so that `DEFRAG` runs every Monday

morning as soon as you power up your PC. If you had a GETDAY utility that returned an exit code of 0 for Sunday, 1 for Monday, and so forth, then the following batch commands would do the trick:

```
GETDAY
IF NOT ERRORLEVEL 1 GOTO NODEFRAG
IF ERRORLEVEL 2 GOTO NODEFRAG
DEFRAG C: /F
DEFRAG D: /F
DEFRAG E: /F
:NODEFRAG
```

GETDAY is easily derived from DOS function 2Ah. Here's the script for creating it:

```
A 100
MOV AH, 2A
INT 21
MOV AH, 4C
INT 21
```

```
NGETDAY.COM
RCX
```

8
W
Q

GETDAY's exit code identifies the day of the week: 0=Sunday, 1=Monday, and so on. Once again, there's absolutely nothing mysterious about how it works. GETDAY first calls DOS function 2Ah to load registers AL, CX, and DX with information about the current date. AL then returns holding the day-of-the-week code so that all that we have to do after the call is terminate with function 4Ch. The exit code can then be tested with an IF ERRORLEVEL command, as shown above.

CONCLUSION Functions 2Ah, 2Ch, and 30h are just three of the numerous programming services that DOS provides. For a complete list of all the DOS pro-

gramming services and their calling conventions, consult the *Microsoft MS-DOS Programmer's Reference* (1991, Microsoft Press) or any of a number of DOS programming guides, such as Ray Duncan's seminal *Advanced MS-DOS* (1986, Microsoft Press). Now that you've seen

how a few of these functions are used, you can draw from these examples to put other functions to work in your own DEBUG programs.

That does it for this time. You've added three more DOS functions to your repertoire of program-

ming resources, and you've become acquainted with several new assembly language instructions. The next Tutor column will expand on this knowledge by introducing some of the services that the BIOS provides, and will further your education in using assembly language to craft compact DOS utilities. □

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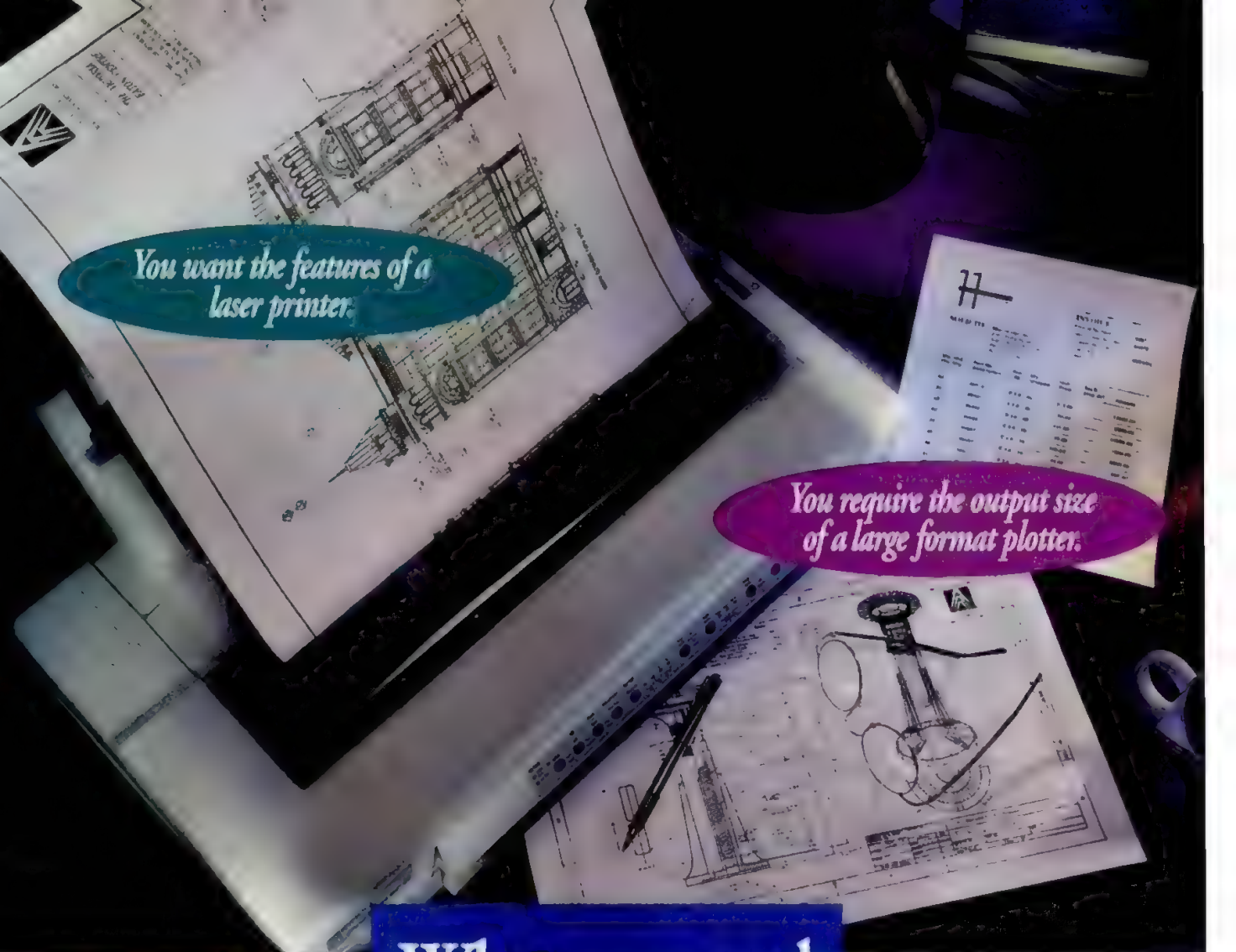
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VL-Bus and PCI: Comparing the Local-Bus Standards

BY WINN ROSCH

The promise of a dramatic, 16-fold increase in PC throughput has given local-bus technology a rapid and enthusiastic reception. If you've recently purchased a high-end PC, it may well already have a local bus somewhere inside; almost certainly the next machine you buy will have one.

There are actually two different proposed local-bus standards that are competing for your attention. One is the VL-Bus, which stands for VESA local bus. (VESA is the Video Electronics Standards Association.) The other is PCI, the Peripheral Component Interconnect, an Intel design. Strictly speaking, neither is a "local bus" in the technical sense, but both deliver what a local bus promises: higher throughput from your input/output devices. Both VL-Bus and PCI achieve this higher throughput by speeding up the bus clock and widening the data path beyond the nominal 8-MHz, 16-bit norm originally established by IBM's PC AT. Both specifications also support, in one way or another, the full spectrum of advanced bus features: interrupt sharing, burst-mode transfers, and arbitrated bus mastering. And both use precision connectors patterned after those used by IBM's Micro Channel architecture.

Beyond these similarities, however, the two local buses differ in fundamental design intent. The VL-Bus is designed to incorporate and extend the features of the conventional ISA, EISA, and Micro Channel expansion interfaces. By contrast, while the PCI bus can be installed in machines with traditional expansion buses, it can also serve as an entirely self-contained expansion bus that provides all the functions now supplied by conventional buses.

In today's PCs, the VL-Bus delivers the most discernible benefit at the lowest cost. But the PCI bus offers an inherently better design that is more likely to form the foundation of future generations of PCs. This Lab Notes will examine why this is so.

THE POINT OF DEPARTURE Local-bus technology is hardly new: If you've still got an original IBM PC or XT in your closet, you own a classic example of local-

lockstep relation between bus and microprocessor. Although in actual practice the AT's processor clock ran at the same speed as its bus clock, IBM had opened the door to the possibility that the microprocessor clock could run *faster* than the bus clock.

Clone vendors took advantage of this separation between clocks to build machines around improved 286 chips that ran at 10 MHz or even 12 MHz (and eventually, around 386 chips that ran at 16 MHz and faster). At the same time, by holding the speed of the expansion bus down to approximately 8 MHz, such vendors could offer compatibility with existing add-in boards, which were not designed to operate at higher speeds. This design approach, which existed before as an unofficial standard, was finally codified as the Industry Standard Architecture (ISA) in 1988.

Besides the limitation on clock speed, however, the ISA architecture imposes another limitation on performance: It requires the microprocessor (or allied motherboard circuitry, such as a DMA controller) to manage all transfers to and from the bus. Thus some of the processor's power must be used to control the minutiae of such operations as writing data back and forth between RAM and a hard disk, and of sending data to a video adapter, a modem, a printer, or a network host adapter. Moreover, during such actions, the whole computer must slow down to the clock rate supported by the expansion bus. Though ISA supports a rudimentary bus-mastering scheme that allows some expansion cards (such as Adaptec's line of bus-master SCSI adapters) to take control of these operations, it provides neither management facilities nor a design standard for such adapters.

It was this inherent shortcoming of the ISA design that led IBM, in 1987, to pur-

***Demands for high-speed
data handling for
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bus design. Simply put, a local bus is one that is directly connected to the CPU. The boards you plug into an XT's expansion bus work exactly the same as they would if they had been hard-wired to the processor socket. And in order to make such a direct connection feasible, the XT expansion bus uses the same bus width (8 bits) and operates at the same clock speed (4.77 MHz) as the 8088 processor itself.

In a true local-bus design, then, the rate at which the external circuitry accepts data from and presents data to the microprocessor must be the same as the rate at which the microprocessor operates. The speed of the microprocessor cannot exceed that of the expansion bus. This keeps things simple, yet it has proved to be a limitation, as faster and faster computers were developed.

When it introduced the higher performance PC-AT in 1984, IBM broke the

sue the radical course of creating a brand-new Micro Channel architecture (MCA) for its PS/2 line of systems. The MCA design allowed for a broader 32-bit data path and a slightly faster 10-MHz clock speed, which gave it a higher potential peak transfer rate of up to 20 MBps, as opposed to ISA's 8 MBps. But more importantly, IBM's brand-new bus design put a special control circuit in charge of the bus, allowing it to operate independently of the speed and even of the type of microprocessor in the system.

Under MCA, the CPU is merely one of several possible bus-mastering devices that can be called upon to manage transfers. The control circuit, called the Central Arbitration Point (CAP), engages in a process called *bus arbitration* to determine and respond to the priorities of each bus-mastering device. Moreover, to permit the use of more plug-in devices, the MCA bus specifies level-sensitive interrupts, which are more reliable than the edge-triggered interrupts of the ISA bus and so allow interrupts to be shared. These innovations set the standard for advanced expansion buses. But they also imposed improved performance standards on expansion boards. So progress came at a price: IBM's new architecture is entirely incompatible with expansion boards built for the ISA bus.

MCA's chief rival, the EISA (Extended ISA) bus, is also based on the ideas of taking bus control from the microprocessor and widening the data path to 32 bits. Reflecting an industry- rather than a company-wide perspective, however, EISA does not freely abandon the requirement of maintaining backward compatibility with existing ISA expansion boards; indeed, EISA uses a novel "one slot fits all" bus connector that is physically as well as electrically compatible with both ISA and EISA cards. But though the EISA specification does support some advanced transfer modes that push its peak transfer rate up to about 33MB per second, the demand for full ISA compatibility saddles EISA with ISA's basic 8-MHz bus speed, resulting in little improved performance in ordinary operation.

The reason that neither MCA nor EISA has totally replaced ISA is simple: These alternatives increase the cost of

PCs (initially by \$1,000; today by about \$300), but do not deliver any easily visible improvement in system performance. Simply plugging a card into an MCA or EISA bus does not of itself unleash its new performance potential; taking advantage of the speedier operating modes of either bus requires installing special software drivers. Moreover, at the time these buses were introduced (1987 to 1988), this extra performance was hardly necessary: Few devices strained the performance limits of the ordinary ISA bus. Adding pain in the form of incompatibilities and extra costs without delivering any gain is not a formula for success.

In contrast, today's local-bus systems *do* deliver observable performance gains in important areas. They require no special drivers to do it, and they add little if anything to the price of a PC.

THE LOCAL BUS TODAY Today's renewed interest in local-bus designs was not stimulated by the shortcomings of the ISA expansion bus per se, but by a specific need: faster video performance. In its first appearance (in the NEC PowerMate line of PCs in 1991), the modern local bus was implemented in the form of an improved display system built into the motherboard; the remainder of the expansion bus did not vary from the practice of the time. NEC's timing was propitious: Windows 3.0 was on the horizon, and higher display resolutions—fostered by NEC's own Multi-Sync line of monitors—were in high demand. With many more bits and colors to push through the data pipeline represented by the expansion bus, the latter had started to become a bottleneck, throttling video performance.

At the time, all but the most expensive display adapters were based on a simple, VGA-inspired frame buffer design. The video adapter simply stores the bits that make up the image. Such adapters have no built-in ability to manipulate this information; the PC's microprocessor must be called upon to move bytes around within the frame buffer. Because the frame buffer is connected to the microprocessor through the expansion bus, the processor must thus slow down to the bus speed whenever it updates a video image. Further, it must read and write data to the frame buffer in 16-bit chunks. Even systems with motherboard-based display systems suffered this slowdown because their graphics circuitry was linked through the standard bus controller.

Local bus designs eliminate this slowdown, allowing the microprocessor to manipulate images at its full speed and bus width. Moreover, as the difference between microprocessor and bus speeds increases, so does the potential improvement that can be realized by using local-bus design. The faster the processor

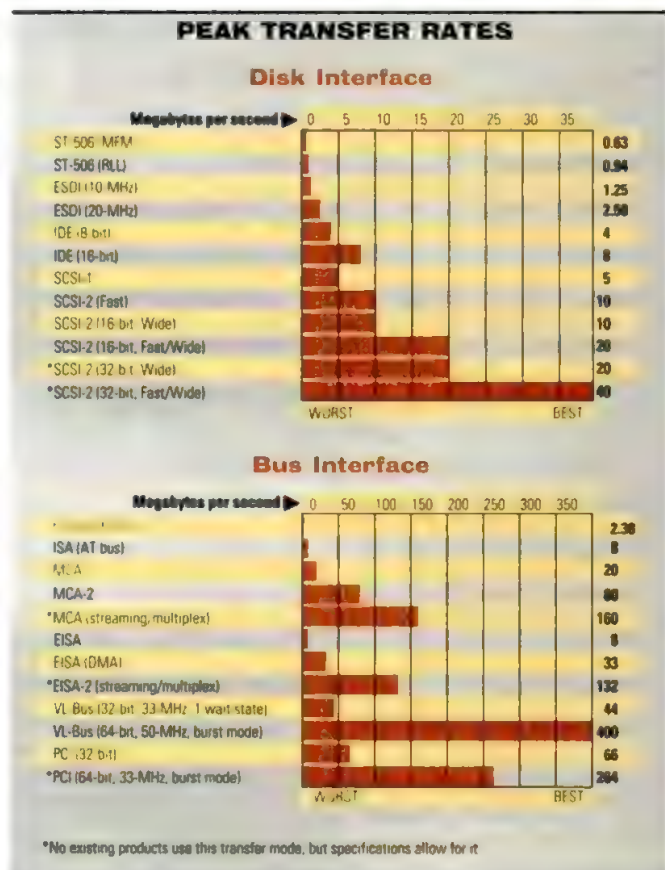


Figure 2: Theoretical peak transfer rates for disk and PC bus interfaces.

8-Bit.



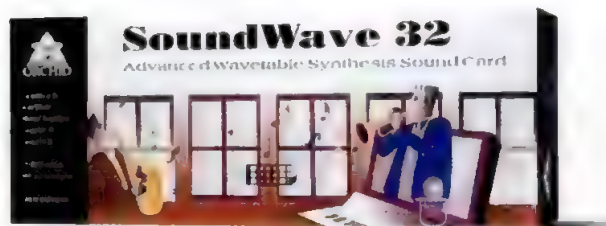
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clock, the greater the improvement that accrues by running a bus at that higher speed rather than at the fixed speed of the ISA bus.

Ironically, soon after local-bus video came to market, the need for it actually diminished. The introduction of fixed-function graphics accelerators, which utilize special-purpose processors to manage the frame buffer, rapidly made all simple frame buffer designs obsolete for high-performance uses. For many common graphics operations, the graphics accelerator can change the screen display without using the expansion bus at all. Only a few operations (such as the job of transferring bitmapped images from disk to display) require extensive use of the bus, which is where the local-bus design has its biggest impact.

Still, non-Windows graphics applications that don't have the special drivers needed to activate the new cards' graphics accelerator functions can still benefit enormously from local-bus technology. Moreover, other devices have recently begun to chafe at the limits imposed by the 16-bit, 8-MHz ISA bus standard. Today's quickest hard disks, for example, have now reached the point where the ISA bus cannot handle their full throughput. Figure 1 compares the effective bus transfer speeds of the most common hard disk interfaces. As it demonstrates, even the relatively slow IDE interface can strain the capacity of an ISA bus if your host adapter is equipped with hardware caching. Clearly, local-bus technology can deliver benefits beyond its original improvement in display performance.

THE VESA LOCAL BUS The downside of building local-bus video circuitry into a PC's motherboard is that it forecloses the future. Video technology evolves rapidly, and whenever a better video controller appears, users of such integrated local-bus systems must give up the local bus (and an expansion slot) in order to take advantage of newer video designs. Although a number of manufacturers have tried to market systems with proprietary local-bus expansion slots, none of these proved successful because none could promise a large enough installed base to justify the development of a good selection of aftermarket display adapters.

Nevertheless, the rapid proliferation

of such systems in late 1991 and early 1992 inspired the Video Electronics Standards Association to develop a unified local-bus expansion design. This has come to be known as the VESA local bus or VL-Bus, a 32-bit design that can also handle 16-bit operations. The first version of the VL-Bus standard was formally ratified by VESA in August

1992. Industry acceptance was instant.

Although originally targeted specifically at advanced video systems, the VESA specification was designed to be broad enough to encompass other peripherals that require high-bandwidth transfers, such as mass storage and network interfaces. Crucially, too, the specification included the pin-out of a connector for local-bus circuits. This made it possible for third parties to design truly interchangeable display adapters and other expansion boards and quickly created a free and open market for such peripherals. Indeed, since preliminary VL-Bus specifications circulated for some months in advance of their formal adoption, compatible products were announced immediately.

The VL-Bus design is aimed at adding to rather than replacing a conventional expansion bus. In fact, the VL-Bus itself includes only one hardware interrupt control line (corresponding to IRQ9), which is used to hook into an ISA, EISA, or MCA bus. This allows VL-Bus peripherals to take advantage of the resources of the other expansion bus (interrupts, DMA control, and the like), including level-triggered interrupts when these are supported by the host bus. VL-Bus expansion cards may also (but need not) include a connector for an ISA, EISA, or MCA traditional bus as well as a connector for the VL-Bus.

Reflecting its origins, the VL-Bus hews closely to the design of the Intel 486 processor. Indeed, it virtually duplicates the signal needs of that chip, except for

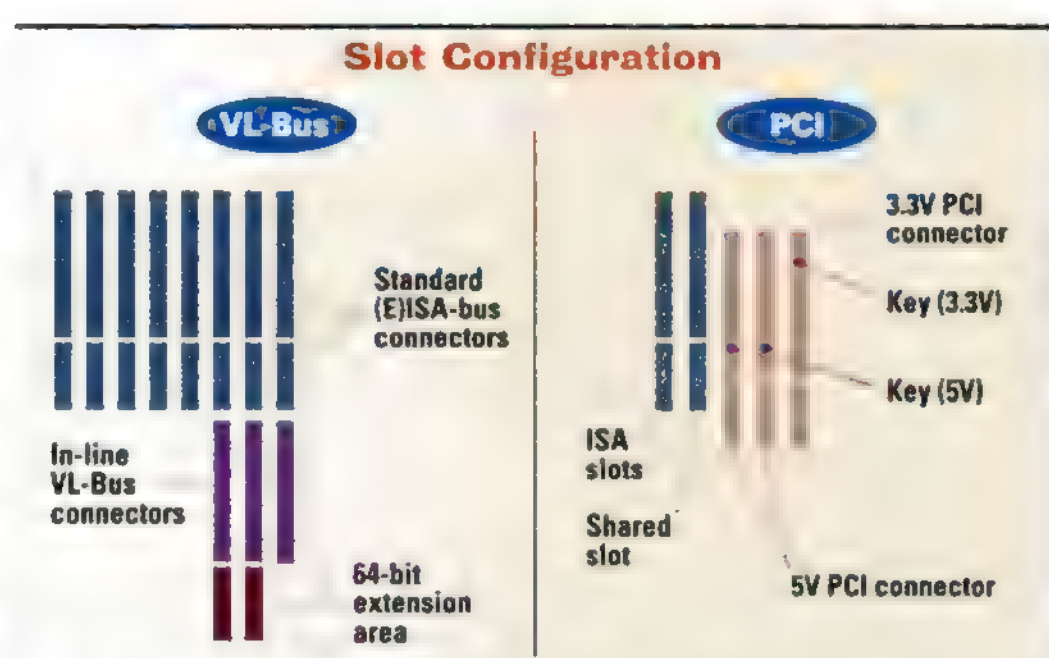


Figure 2: VL-Bus connectors are implemented as in-line extensions to the ISA, EISA, or MCA bus connectors. PCI connectors, by contrast, may be either shared (in a side-by-side layout) or standalone.

a few signals that are defined more broadly so as to maintain compatibility with 386 processors. Its physical embodiment is a standard Micro Channel-style connector installed in line with a standard bus connector, as shown in Figure 2. It has 112 contacts in two rows of 56, spaced at 0.05 inches, and it supports 32 data lines and 30 address lines, sufficient to address 4 gigabytes of RAM using the 486's 4-byte memory addressing method.

In its simplest form, VL-Bus provides little more than a set of unbuffered address, data, and control signals that are directly connected to the host microprocessor. PC makers can add buffering to add more slots, but in doing so they must sacrifice bus speed. The VL-Bus specification as such sets no upper (or even lower) limit on clock speed, but more connectors mean more electrical capacitance, which causes reliability to suffer as frequency increases. In practice, the VL-Bus cannot run faster than about 66 MHz.

For this reason, the original VL-Bus specification recommends that designers use no more than three local-bus devices (whether slot-mounted or integrated into the system board) in systems that operate at speeds of up to 33 MHz. At higher bus speeds, the device count narrows: At 40 MHz, only two devices (one of them slot-mounted) can be accommodated; and at 50 MHz, only one device, which must be integrated with the board, is recommended. In practice, the best combination of performance and features is to be found at 33 MHz.

Though VL-Bus offers far fewer bus

slots than ISA, this is not necessarily a handicap, for few types of devices can truly benefit from the speed of a local bus. In fact, most PCs need only a maximum of three such high-speed connections: one for video, one for a disk controller or host adapter, and one for a network adapter. Moreover, a system designer who wants to create a PC with more than three VL-Bus slots can do so by building in multiple VL-Bus subsystems, each of which can hold up to three slots. There is no real limit on the number of subsystems that can be installed in a single PC.

Unlike MCA, automatic configuration is not part of the VL-Bus specification. It's left up to the board makers to decide whether to design products that are set up with jumpers and DIP switches or to devise their own installation software to alter on-board EEPROM-based configurations. In either case, the VL-Bus is invisible to software; no drivers are necessary in order to take advantage of its higher speeds.

After the 1993 introduction of Intel's powerful 64-bit Pentium processor, VESA began working on a new VL-Bus standard (Version 2.0), which was in preliminary form at the time of this writing. The revised specification defines a 64-bit interface based on a 32-bit Micro Channel connector. It maintains full backward compatibility with the current VL-Bus specification: Boards designed to the old standard will work in new VL-Bus PCs, and new 64-bit boards will even be able to operate in old 32-bit systems, though of course as 32-bit devices.

The new 2.0 specification also redefines the maximum number of VL-Bus slots permitted in a single subsystem. It now allows up to three slots at 40 MHz and two slots at 50 MHz, provided that the system uses a low-capacitance design. It also supports write-back caching, which can minimize the number of necessary disk updates by accumulating data to be written in a buffer and then writing it all at once at an opportune moment. Finally, it adds a new status signal that the bus can use to identify 486-based systems that support the high-speed burst protocols from which some newer peripherals can benefit.

INTEL'S IDEA Intel Corp. introduced its own local-bus specification, called Pe-

ripheral Component Interconnect or PCI, in July of 1992. Long awaited as Intel's official conception of what a local bus for today's advanced processors should be, the initial design proved to be both more and less than the industry had hoped for.

On the one hand, the initial PCI specification was admirably complete in terms of defining the mandatory design rules and hardware guidelines necessary to assure proper circuit operation. But it fell silent at exactly the point where the industry most wanted hard information: the pin-out of an expansion bus connector that would allow the design of interchangeable expansion boards. Fortunately, this omission, which had effectively left the field to the VL-Bus,

***PCI's explicit purpose is to
make the lives of those
who engineer chip sets and
motherboards easier.***

was remedied in a revision and extension of the specification that was completed in May 1993. This new PCI 2.0 specification also broadened the data path to 64 bits so as to support the Pentium.

One of PCI's strengths is its ability to accommodate the most advanced trends in PC hardware design. It is designed for use in a multiprocessor environment, and it envisions the use of high-performance peripherals for multimedia and other data-intensive applications. It supports arbitrated bus mastering (the handling of interrupts on the basis of the priority of each claimant), it has its own bus command language (a four-bit code), and it supports secondary caches directly.

PCI's more explicit purpose, however, is to make the lives of those who engineer chip sets and motherboards easier. Whereas each new Intel microprocessor family once required the makers of chip sets and motherboards to redesign their products completely, PCI holds out the promise of a common standard that is independent of the microprocessor family. In fact, PCI is so processor-independent that it will work with Digital Equipment

Corp.'s Alpha and other non-Intel chips.

A related benefit of the PCI standard is the elimination of what system designers call *glue logic*, the profusion of integrated circuits commonly required to connect the big VLSI (very large-scale integration) chips that make up a modern computer system. Chips that follow the PCI standard religiously should be directly connectable to one another. Though this may seem to be a minor consideration, the lower number of parts that result from adhering to the standard will trickle down to users in the form of reduced cost and greater reliability: Fewer chips installed means fewer chips failing, as well as fewer to pay for.

In its current form, then, the PCI specification creates an open and available industry standard to which chip makers can design their products. Such an open standard should help third-party manufacturers create a wide variety of chips with specialized functions, including not only video controllers but also SCSI controllers, LAN adapters, and audio and video products for multimedia systems. It should also result in design standardization that will enable PC makers to include more standard functions on their system boards, thus saving much of the cost involved in adding expansion boards.

An expansion board designed to the PCI standard should work in any system, whether it is based on the ISA, EISA, or Micro Channel bus design. This is because at least initially, PCI is expected to supplement, not replace, the buses in most systems. Physically, indeed, it will fit in as an extension to any of the three, as can be seen in Figure 2.

The PCI bus uses a 124-pin Micro Channel-style connector (188 pins in its 64-bit implementation). But only 47 of these connections are used by an expansion board (49 if it is a bus-mastering adapter); the balance is accounted for by multiple power supply and ground signals. Every active signal on the PCI bus is either next to or opposite a power supply or ground signal, a technique that minimizes stray radiation.

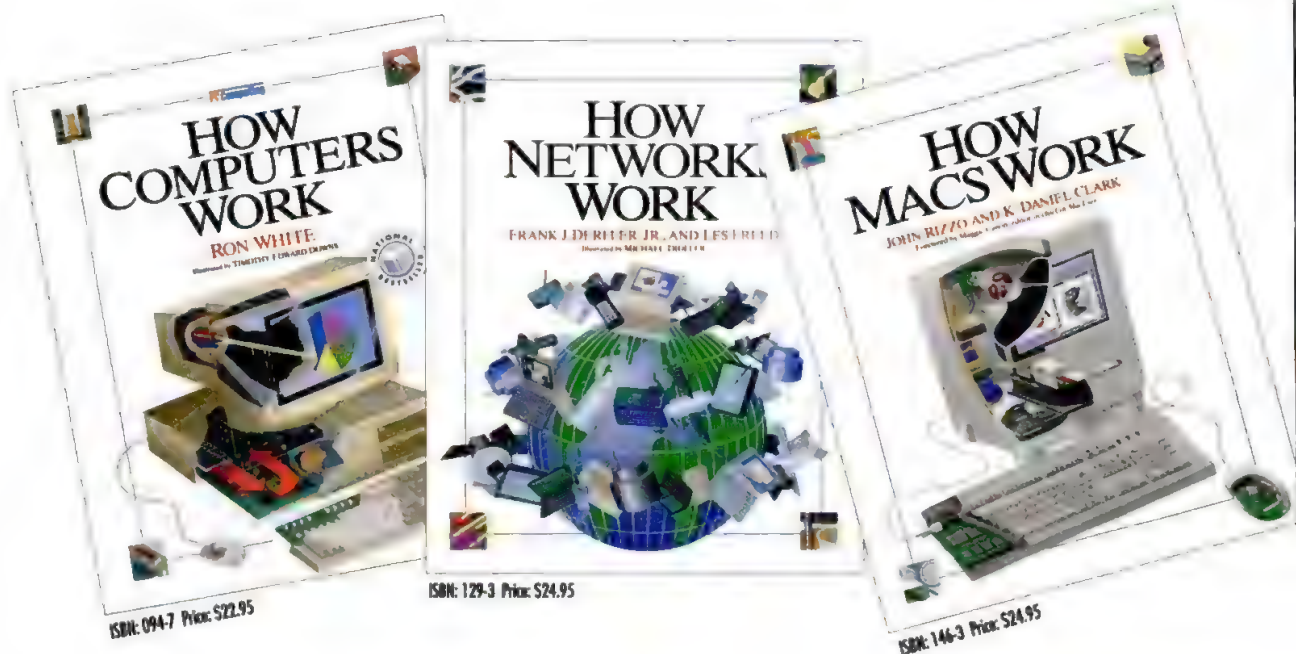
For the same reason, the PCI specification provides guidelines for the physical configuration of components on the motherboard, plus design rules that will

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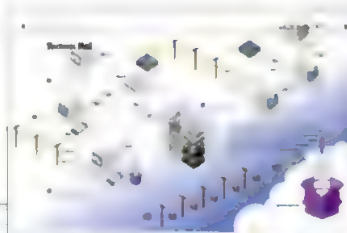
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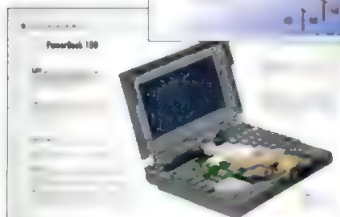
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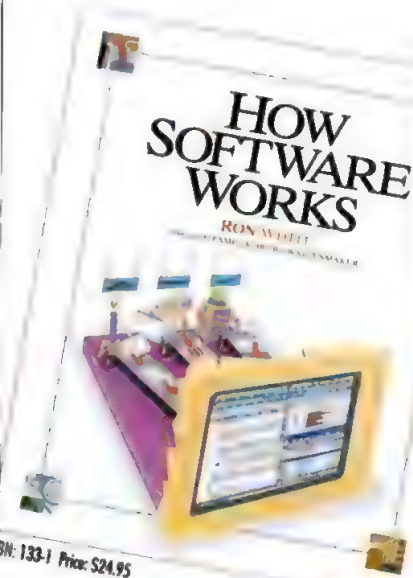
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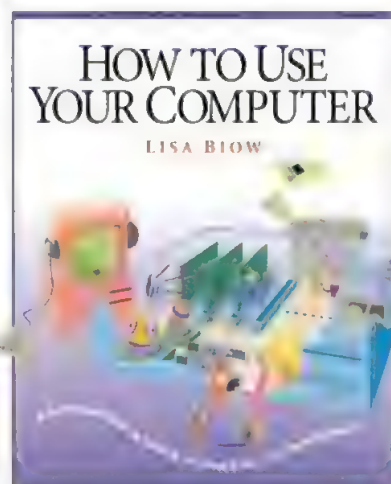
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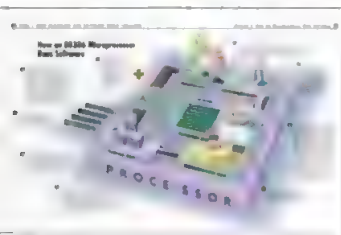
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minimize the length of the bus and the capacitive effects that would restrict its operating frequency. Even with such care, however, the practical limit on the number of PCI bus connectors is three; as with the VL-Bus, more connectors would increase bus capacitance and make full-speed operation less reliable.

Although it delivers performance similar to that of a directly connected local bus, PCI is in fact one step removed from the microprocessor. Indeed, it is sometimes described as a "mezzanine" bus. Instead of having its own clock, a PCI bus is locked to the clock used by the microprocessor and its support circuitry, so PCI components are normally synchronized with the host processor. The current PCI standard authorizes operating clock frequencies ranging from 20 MHz to 33 MHz; it also allows the bus to be slowed to a dead stop for use with laptops and green PCs, where power saving is a prime consideration.

Following the same green line, the PCI specification anticipates an eventual switchover from standard 5V logic to power-saving 3.3V operation. To facilitate the development of environmentally sensitive PCs, PCI actually specifies two connector types—a 5V connector for today's prevailing circuit designs and a 3.3V connector for low-power designs—and specifies how manufacturers can combine both connectors on a single expansion board for a smooth transition between designs. Its sockets are keyed to prevent the insertion of the wrong type of boards; boards capable of discriminating between the two voltage regimes have slots that allow them to fit both types of sockets.

Like MCA and EISA, PCI supports software configuration without the need to set jumpers or DIP switches. All PCI expansion boards must include 256 registers intended to store configuration information, and the content and arrangement of these registers are tightly specified to ensure compatibility among all PCI boards. A special signal dedicated to each slot is used to read and write configuration information.

BEYOND THE BUS WARS The reason to care about local-bus designs is their speed, and performance-wise, both VL-Bus and PCI are designed to vastly ex-

ceed the 8 MBps maximum throughput of the ISA bus. The original VL-Bus, running at 33 MHz, is claimed to attain a peak throughput of 132 MBps. The wider bus and faster clock speeds in VL-Bus 2.0 specification push its theoretical throughput up to 400 MBps, while Intel claims PCI can reach 132 MBps throughput in 32-bit operation or 264 MBps in 64-bit operation.

These theoretical figures are useful as consistent benchmarks for comparison, but in a real-world context they must be viewed with caution. The maximum rates are based on the use of high-speed burst modes, in which a single address cycle can be followed by multiple data cycles that access sequential memory locations. In practice, however, relatively few bus transfers can take advantage of these

***PCI's advanced
architecture will probably
make it a more enduring
standard for processors
more powerful than the
486 standard of today.***

high-speed transfer modes. Both buses reach their peak transfer rates only during brief bursts that last microseconds at most. And system overhead further cuts into the time available for bus transfers, even under the best of conditions.

For nonburst transfers, the original VL-Bus specification requires the same two clock cycles (one for the address and the other for data) as do other buses. This prerequisite alone reduces its maximum potential throughput from 132 MBps to somewhere around 66 MBps. And when you then count in the wait states it requires for read operations (and for write operations at clock speeds above 33 MHz), its actual throughput is reduced still further, to no more than about 44 MBps. For similar reasons, the PCI bus in typical operation cannot attain a peak transfer rate greater than about half its burst rate, for a maximum of about 66 MBps across a 32-bit connection.

In the area in which local-bus design makes the most visible difference today—video performance—its benefits are fairly modest. Under the best conditions, the speed increase is about 30 percent. And under Windows and other graphical environments, a graphic accelerator provides an equal, sometimes greater speed boost than local-bus video; combining the two buys only about an additional 10 percent in performance over accelerator technology alone. Still, as microprocessors get faster, the local bus will help more. And as these relatively small gains come at almost no cost, they are hardly to be scorned.

In fact, the combination of high speed and easy adaptability explains why VL-Bus is now well on the way to becoming ubiquitous in the 486 marketplace. It brings more responsive video and faster mass storage transfers to ordinary ISA systems at a minimal extra cost. Yet it suffers from none of MCA or EISA's compatibility worries; indeed, when combined with EISA, it is an excellent way to get the bus mastering, interrupt sharing, and other advanced features of this bus in a faster form.

Technically, PCI is more advanced than the VL-Bus, as it starts with the advantage of fresh, from-the-ground-up design with the aim of supporting promising technologies and future growth. The first commercial PCI machines are not likely to appear until late 1993 or early 1994. (They might have appeared earlier, but the first PCI chip set that Intel designed proved to be flawed and had to be redone.) But PCI's advanced architecture will probably make it a more enduring standard for processors more powerful than the 486 standard of today.

All things considered, if you're in the market for a 486 today, don't avoid the VL-Bus just because you suspect PCI will be the wave of the future. The PC industry has already made an extensive commitment to the VL-Bus, and peripherals using it will likely be available over the full lifetime of your next PC. PCI is something to look forward to tomorrow; VL-Bus is something to get your hands on today. □

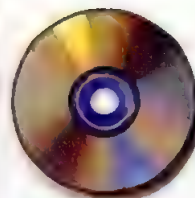
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Fire Up Windows Programs Fast with HK.EXE

BY DOUGLAS BOLING

Do you find it tedious to grope for a mouse, open a group, and then locate and double-click on an icon just to get to an application you want to launch? If so, it must be all the more irritating to know that it's quite possible for a keyboard veteran to have a program up and running before you even start to double-click.

Microsoft provided a way to assign hotkeys to applications in Microsoft Windows 3.1's Program Manager, but this support is inadequate in several ways. For one thing, unless the Program Manager has the current focus, Microsoft's hotkeys won't actually launch the application; they take effect only if the program has already been started. For another, the allowable hotkey combinations you can employ are severely limited.

HK.EXE, this issue's free Windows 3.1 utility, solves both these problems. With HK, pressing the hotkey brings up your application even if it is not yet running. And HK offers a much wider selection of possible keystrokes to use for hotkeys than the Program Manager. Configuring HK to implement your hotkey selections is simplicity itself.

You can obtain HK.EXE or HK.ZIP, which includes its C language source code, by following the instructions in the sidebar "How to Get PC Magazine's Utilities." If you want to modify and compile the code, you'll need either Microsoft's C 6.0 or Borland's C++ 3.1 (or a compatible) compiler, and if your compiler does not already include the files needed for compiling a Windows 3.1 program, you'll also need the Windows 3.1 Software Development Kit. We've included a make file for the Microsoft C 6.0 compiler; if you use another compiler,

you'll have to refer to its manual for the proper syntax.

USING HK You install HK simply by copying or unzipping its files into a sub-directory and then adding an icon for it in the Program Manager, just as you would with any other Windows program. Since you'll probably want the program to be running all the time, you'll most likely want to drag its icon into the Startup group window; in this case, you'll want to check the Run Minimized box in

Windows 3.1 can be just as fast as a keyboard-based environment when you use this issue's program-launching hotkey utility.

the Program Item Properties dialog box to ensure that HK is started as an icon.

To assign a hotkey to an application, just bring up HK by entering its pathname in the File | Run menu of the Program Manager, or by double-clicking on its icon there or on the desktop. You'll then see a dialog box that contains a list of the current hotkeys and a set of buttons down the right side (see Figure 1).

To add a new hotkey, click on the Add button. HK will bring up a dialog box with two entry fields. The first is for the program name and any additional command line parameters. If the program file is in your Windows directory or in a directory in your path, the program name alone will suffice. Otherwise you'll need to enter the complete drive, path, and filename for the application. If you can't remember the program's location, clicking on the Browse button will present you

with a file selection box that will ease your search.

After filling in the command line, click on or tab over to the hotkey entry field and press the hotkey combination you want to assign to this program. The names of the keys you press will be displayed as you press them: For example, if you press the H key while holding down the Shift and Ctrl keys, the box will display "Shift + Ctrl + H". Then click on the Add button in the Add dialog box to save your program and your hotkey selection. (Clicking on the Cancel button will close the Add dialog without saving the new hotkey selection.)

Almost any shift combination, along with a letter, number, or other symbol, is allowed, with the following exceptions: You cannot use combinations (such as Alt-Esc) that are used by Windows as systemwide command keys, and you cannot select any combination that uses the Tab key. You should use your freedom in assigning hotkeys carefully, however, for hotkey settings override all the accel-

Top 10 Windows Utilities

Rank	Utility
1	BUGS - Windows 3.1 screen saver
2	INCTRL - Installation control
3	CLIPST - Extends the clipboard
4	WINCMD - Command-file interpreter
5	CHANGER - Changes look of desktop
6	RCLICK - Puts menu bars at cursor
7	FNTPRN - Catalogs your fonts
8	WPRINT - Prints in Windows 3.1
9	WINTIDY - Organizes Program Manager
10	WTIME - Keeps PC clock accurate

This list is based on the total number of downloads each utility has had on PC MagNet over the past 12 months. To download these files, type GO ZNT:TIPS. For more information, see the sidebar "How to get PC Magazine's Utilities."

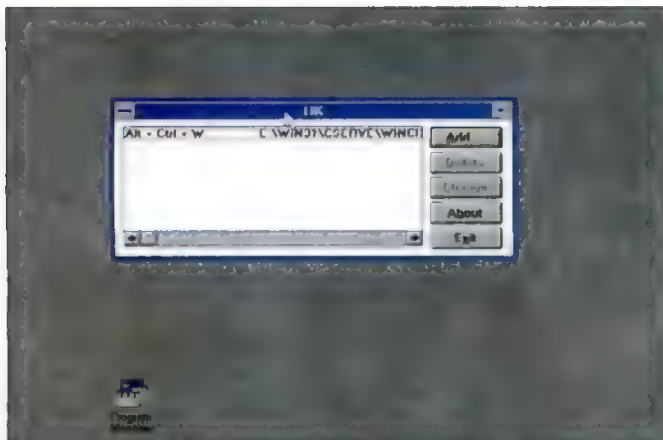


Figure 1: When you start HK with the File | Run command or by double-clicking on its icon, you'll be presented with this dialog box.

erator keys in all your Windows applications. For example, if you assign Alt-F to the Windows Notepad, you'll no longer be able to display the File menu in any Windows application. And if you use ProComm in a DOS box, don't use HK to assign its exit key combination (Alt-X) to another program, or you won't be able to get out of your communications session!

After you add a hotkey, HK will display it, along with its program name, in the HK list box. You can delete a hotkey by selecting it on the list and clicking on the Del key; this will disable the hotkey and remove it permanently from the list. Note that if the application associated with a deleted hotkey is currently run-

ning, HK will disable the hotkey, but it will not terminate the application.

You can edit a hotkey combination by selecting the hotkey in the list box and clicking on the Change button, or else by double-clicking on the hotkey selection. A dialog box similar to the Add dialog box will be presented, its fields filled in with the current settings

for that key. Both the command line and the hotkey can be changed at this point. To put your changes into effect, press the Change button again; to discard the changes, click on the Cancel button.

The remaining two buttons in the HK window are the About and Exit. Clicking on the About button displays information about the program version, the copyright notice, and the author's name. Pressing the Exit button ends HK. Note that when you terminate HK, the hotkey combinations for programs not already started are disabled, but you can still use the hotkeys for applications that were started with HK. All of your assigned hotkey settings are saved in a file (HK.INI) so that they will automatically

be restored the next time you start it up.

UNDOCUMENTED MESSAGES The key to HK's operation lies in its use of two undocumented messages, WM_GETHOTKEY and WM_SETHOTKEY. I learned of the existence of these messages by reading Andrew Schulman's superb *Undocumented Windows* (Addison-Wesley, 1992, \$39.95), a book I consider invaluable for programmers interested in discovering how Windows works under the hood. As their names imply, the two messages allow a program to assign a hotkey to a window on the screen. They are, in fact, the very messages that the Program Manager itself uses to set hotkeys.

The WM_SETHOTKEY message takes one value, which is passed in the wParam parameter. (The lParam value is not used and its value should be 0.) The low byte (bits 7 through 0) of wParam contains the *virtual key code* for the hotkey. For plain ASCII characters, the virtual key code is simply the ASCII code; for nontext keys, Windows has a defined set of VK_XXX constants—for example, VK_F1, VK_DOWN, and so on. The high byte (bits 15 through 8) contains the shift bits for the hotkey. Figure 2 diagrams the wParam field as used by WM_SETHOTKEY.

To assign a hotkey to a window, an application sends a WM_SETHOTKEY message to the window, with the hotkey encoded in wParam. For example, to assign Alt + Ctrl + N to a window, the pro-

■ The 'Take Command of Windows' Contest

PC Magazine and ZiffNet challenge you to take command of your Windows environment and win a Sony Discman. WINCMD is a *PC Magazine* utility that lets you create simple Windows batch programs. Write a script that automates a Windows operation and enter it in the Take Command of Windows Contest.

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Gift Bag. All entries will be judged by contributing editor Douglas Boling (WINCMD's author).

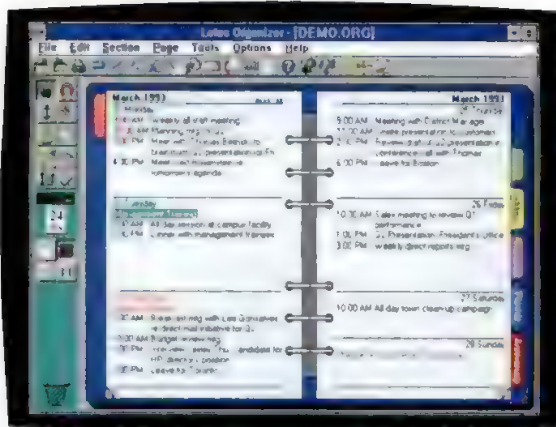
To obtain the official entry form, rules, and program files, download ENTER.TXT, WINCMD.EXE, and its function library, WCLIB.WCL, from *PC Magazine's* Utilities/Tips Forum (GO ZNT:TIPS). If you don't have a modem, you can request the form, rules, and files by mail or phone: Send a postcard to WINCMD Contest, *PC Magazine*, One Park Ave., New York, NY 10016-5802, or call 212-503-4550. (WINCMD was published in the April 27, 1993, issue; WCLIB.WCL

was in the May 25, 1993, issue.)

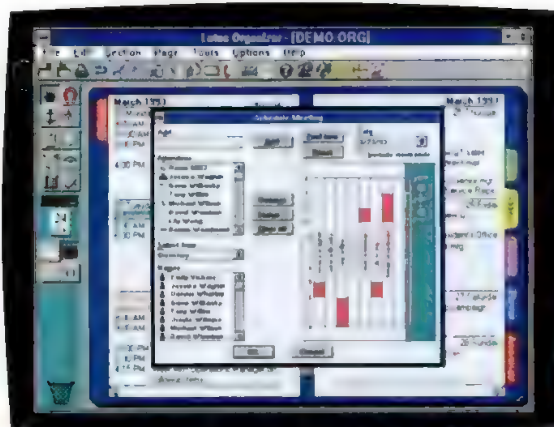
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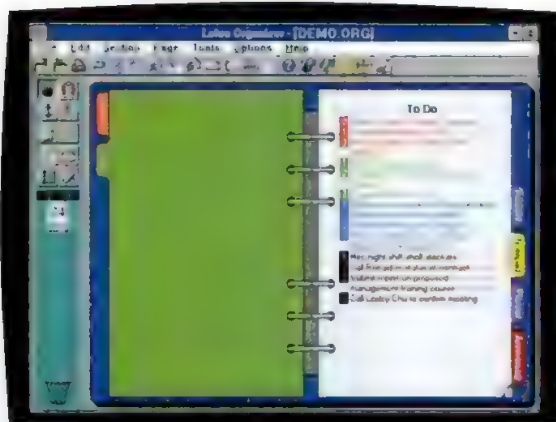


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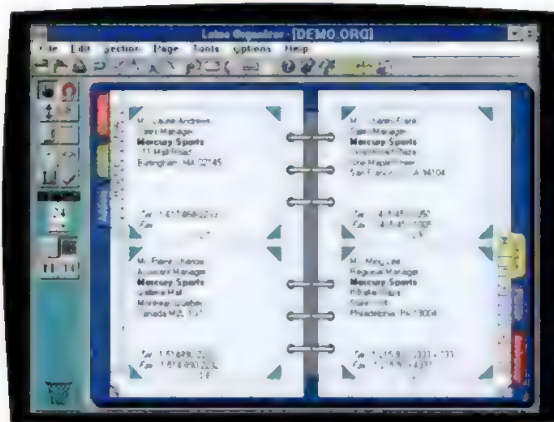


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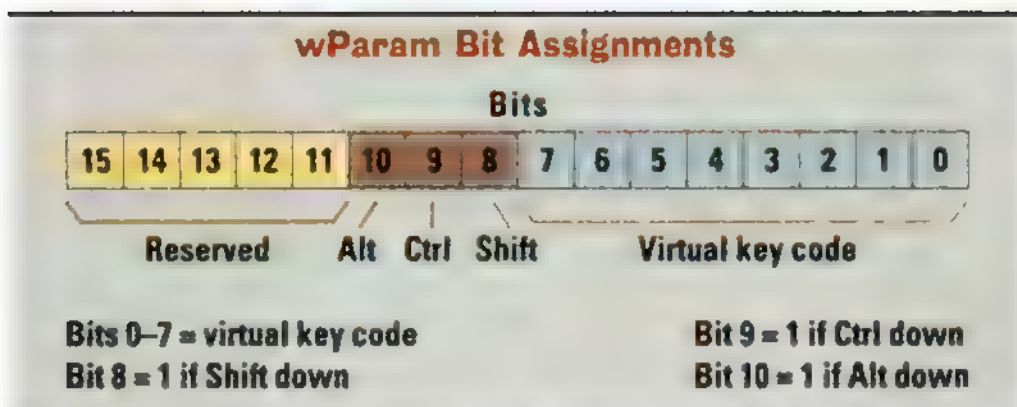


Figure 2: The wParam parameter of the undocumented WM_SETHOTKEY message is used in assigning hotkeys to programs.

gram would send a WM_SETHOTKEY message to the window, with the wParam value set to 064E (hex). The 6 is the sum that results when bits 9 (Ctrl) and 10 (Alt) are set. The 4E is the virtual key code for the N key.

Depending on the result of the message, WM_SETHOTKEY returns one of four codes. A return code of 0 means that the window handle was invalid. A return code of 1 means the hotkey was successfully set. A 2 signifies that the hotkey was invalid, and a -1 indicates that the hotkey is already owned by another application.

When an application sends the WM_GETHOTKEY message to a window, the return value contains either the hot-

tual key code in the low byte of the low word and the shift values in the high byte of the low word. The high word of the dword return value is unused.

INSIDE HK HK is composed of two major components: the user interface code and the hotkey code. The former manages the HK main window, displays the hotkey settings in the list box, responds to the window controls, and saves and restores the hotkey values in the HK.INI file. The latter monitors for hotkey presses, launches applications, and monitors the applications to determine whether they have terminated.

Most of the HK user interface consists of boilerplate Windows code. These in-

clude the standard program initialization code and message loop, as well as routines that handle each of the window controls. (Interested readers can refer to Charles Petzold's *Programming Windows*, Second Edition, Microsoft Press, 1990, for a thorough discussion of these matters.) However, the portion of the user interface code that deals with creating the hotkey entry field in the Add dialog box deserves some comment. It is shown in Figure 3.

Typically, an edit box simply displays the characters you enter, but the standard edit box isn't up to the job of displaying hotkey combinations, because many hotkey values are not displayable characters. I wanted the hotkey edit box to show both the key being pressed and the state of each of the shift keys, and this required a bit of work.

One way to create this type of an edit box would be to create a new window class that would do exactly what was necessary. The new class would need a window procedure to handle a variety of messages such as WM_PAINT, WM_CHAR, and so forth. While this method will certainly work, a simpler ap-

Editbox Complete Listing

```
//=====
// Editbox subclass procedure
//=====
LONG CALLBACK EditBoxProc (HWND hWnd, UINT wMsg, WPARAM wParam,
LONG lParam) {
    char szKeyText[80];
    static LONG lLastKey;

    switch (wMsg) {
        case WM_SYSKEYDOWN:
            if ((wParam == VK_TAB) || (wParam == VK_SPACE) ||
                (wParam == VK_ESCAPE))
                break;
        case WM_KEYDOWN:
            // Ignore repeat WM_KEYDOWN messages
            if (lParam == lLastKey)
                return 0;
            lLastKey = lParam;
            // Turn key state into text
            wAddKey = wParam;
            szKeyText[0] = '\0';
            if (lParam & 0x20000000)
                wAddKey |= 0x400;
            if (GetKeyState (VK_CONTROL) & 0x0000)
                wAddKey |= 0x200;
            if (GetKeyState (VK_SHIFT) & 0x0000)
                wAddKey |= 0x100;
            // Hide extended key bit in VK word
            if (lParam & 0x10000000)
                wAddKey |= 0x1000;

            SetWindowText (hWnd, DispKeyText (wAddKey, szKeyText,
            sizeof (szKeyText)));
            return 0;

        case WM_SYSCHAR:
        case WM_SYSKEYUP:
            if ((wParam == VK_TAB) || (wParam == VK_SPACE) ||
                (wParam == VK_ESCAPE))
                break;
        case WM_KEYUP:
```

```
        case WM_CHAR:
            return 0;
    }
    return CallWindowProc (lpfnOldEditWndProc, hWnd, wMsg,
        wParam, lParam);
}
//-----
// DispKeyText - Converts a key value into text
//-----
char *DispKeyText (UINT wKey, char *pszOut, INT sOutMax) {
    UINT wFlags;

    sOutMax--;
    *pszOut = '\0';

    if (sOutMax < 6) return pszOut;
    if (wKey & 0x400) {
        strcat (pszOut, "Alt + ");
        sOutMax -= 6;
    }
    if (sOutMax < 7) return pszOut;
    if (wKey & 0x200) {
        strcat (pszOut, "Ctrl + ");
        sOutMax -= 7;
    }
    if (sOutMax < 8) return pszOut;
    if (wKey & 0x100) {
        strcat (pszOut, "Shift + ");
        sOutMax -= 8;
    }
    if (wKey & 0x1000)
        wFlags = 0x300;
    else
        wFlags = 0x200;

    wKey &= 0xff;
    if ((wKey != VK_CONTROL) && (wKey != VK_MENU) &&
        (wKey != VK_SHIFT)) {
        GetKeyNameText (MAKELONG (0, wFlags | MapVirtualKey(wKey, 0)),
            &pszOut[strlen (pszOut)], sOutMax);
    }
    return pszOut;
}
```

Figure 3: A listing of the edit box subclass procedure.

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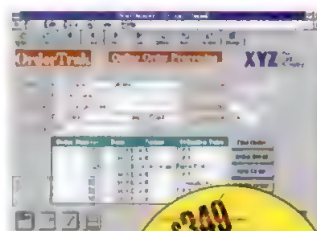
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proach is to take advantage of the Windows code already written to support the edit box. The key to this simpler method is a technique called *subclassing*. Subclassing a window allows a program to customize a window's operations while still using its built-in functions. In the case of the hotkey edit box, HK subclasses the standard Windows edit box control.

The standard edit box window procedure handles almost all the tasks required of a window, including initialization, painting, and termination. The EditSCProc subclass procedure in Figure 3 handles only six of the hundreds of messages that are sent to an edit box procedure.

The rest are passed on to the original edit box window procedure for processing.

Most of the code in the subclass procedure is needed to process the WM_KEYDOWN message. This message normally causes the edit box to add a character to its displayed text, but in this case the EditSCProc procedure intercepts the WM_KEYDOWN message, thus preventing it from reaching the edit box procedure. EditSCProc replaces the normal text with a string that indicates the current shift state and any other single key that is pressed.

The WM_KEYDOWN message, which notifies the focused window that

a key has been pressed, has two parameters: wParam, which is the virtual key code, and lParam, which contains other information about the key, including its scan code, the current repeat count, and a number of other state flags. The EditSCProc procedure copies the virtual key code into the low byte of the global variable wAddKey.

The state of the Shift and Ctrl keys are checked using Windows' GetKeyboardState() function; the Alt key does not have to be checked in the same way, since its state is already encoded in the context code bit (bit 29) of lParam. For each of the shift keys, EditSCProc sets a bit in

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HKChildWndProc

Complete Listing

```

//-----
// HKChildWndProc - Callback function for HotKey Child
//-----
LONG CALLBACK HKChildWndProc(HWND hWnd, UINT wParam, LONG lParam) {
    PHKEYENTRY phkPtr;
    DWORD dwData;
    WORD wKey;
    INT sEnabled;
    HANDLE hExecInst;
    HWND hwndLast;

    switch (wParam) {
        case WM_CREATE:
            phkPtr = (PHKEYENTRY*)((LPWORD)((LPCREATESTRUCT) lParam)->lParam);
            SetWindowLong (hWnd, 0, MAKELONG (phkPtr->wKey, 0));
            PostMessage (hWnd, WM_SETHOTKEY, phkPtr->wKey & 0xffff, 0);
            return 0;

        case MYMSG_ENABLEHK:
            if (wParam == 3) {
                ShowWindow (hWnd, SW_SHOWNOACTIVATE);
                break;
            }
            dwData = GetWindowLong (hWnd, 0);
            wKey = LOWORD (dwData);
            SetWindowLong (hWnd, 0, MAKELONG (wKey, wParam));
            return 0;

        case WM_SETFOCUS:
            SetFocus (hMain);
            return 0;

        case WM_ACTIVATE:
            // sEnabled: 0 = Window created 1 = Armed.
            // 2 = Prog Launched -1 = Disabled
            hwndLast = LOWORD (lParam);
            dwData = GetWindowLong (hWnd, 0);
            sEnabled = HIWORD (dwData);
            wKey = LOWORD (dwData);

            switch (wParam) {
                case WA_INACTIVE:
                    if (sEnabled == 2) {
                        SetWindowLong (hwndLast, 0, MAKELONG (wKey, -1));
                        if (hwndLast)
                            SendMessage (hwndLast, WM_SETHOTKEY, wKey, 0);
                    }
                    break;

                case WA_ACTIVE:
                    phkPtr = FindHKEntry (wKey);
                    if (phkPtr == 0) {
                        SetWindowLong (hWnd, 0, MAKELONG (wKey, -2));
                        break;
                    }
                    if (sEnabled == 0) {
                        SetWindowLong (hWnd, 0, MAKELONG (wKey, 1));
                        SetWindowPos (hwndLast, HWND_BOTTOM, 0, 0, 0, 0,
                                    SWP_NOMOVE | SWP_NOSIZE);
                    } else if (sEnabled == 1) {
                        if (!hwndLast) break;
                        if ((GetWindow (hwndLast, GW_HWNDLAST) == hwndLast) &&
                            (!IsIconic (hwndLast))) {
                            SetActiveWindow (GetWindow (hMain, GW_HWNDNEXT));
                            break;
                        }
                        SetWindowLong (hWnd, 0, MAKELONG (wKey, 2));
                        hExecInst = WinExec (phkPtr->szCmdLine, SW_SHOWNORMAL);
                        if (hExecInst < 32) {
                            SetWindowLong (hWnd, 0, MAKELONG (wKey, -1));
                            PostMessage (GetWindow (hWnd, GW_OWNER),
                                        MYMSG_HKWINERR, hExecInst, (LONG) wKey);
                            PostMessage (hWnd, WM_CLOSE, 0, 0);
                            if (hwndLast)
                                SetActiveWindow (hwndLast);
                        }
                    }
                    break;
            }
            return 0;

        case WM_CLOSE:
            DestroyWindow (hWnd);
            return 0;
    }
    return DefWindowProc (hWnd, wParam, lParam, 1);
}

```



Figure 4: The window procedure for the hotkey window class.

the high byte of `wAddKey`. The format of `wAddKey`, which comprises the virtual key code and bit flags for the shift keys, matches the format of `wParam` in the `WM_SETHOTKEY` message.

The `DispKeyText` routine, also shown in Figure 3, returns a text description of the `wAddKey` contents. The routine checks for each of the Shift flags and, if any are found, appends the appropriate text for the keys. The description of the virtual key code is obtained by calling Windows' `GetKeyNameText` function. The `EditSCProc` function takes the string returned by `DispKeyText` and calls `SetWindowText` to place it in the edit box.

The other messages that are handled by `EditSCProc` are parsed in order to keep them from reaching the original edit box window procedure. The `WM_SYSKEY` and `WM_SYSCHAR` messages are stopped to prevent any hotkey combinations from being processed as system commands. Three specific combinations,

Alt-Spacebar, Alt-Tab, and Alt-Esc, are passed on to the edit box procedure so that their normal associated actions will not be affected. The `WM_KEYUP` and `WM_CHAR` messages are stopped so that the edit box procedure does not try to place any characters in the edit box on its own.

Aside from the subclassing of the hotkey edit box, the Add dialog must also prevent any Alt-key combinations in the hotkey edit box from acting as accelerator keys. This is done by parsing the `WM_SYSCOMMAND` message in the AddKey dialog procedure, searching for an `SC_MENU` command (which indicates an accelerator key), and checking to see whether the hotkey edit box has the focus. If these conditions are met, the `WM_SYSCOMMAND` message is discarded.

Once the hotkey and the command line are entered, HK saves the combination in a list of structures called the hotkey list. This list also contains the status

flags for every hotkey configured by the user. The list is saved when the program terminates, and it is restored when HK is restarted.

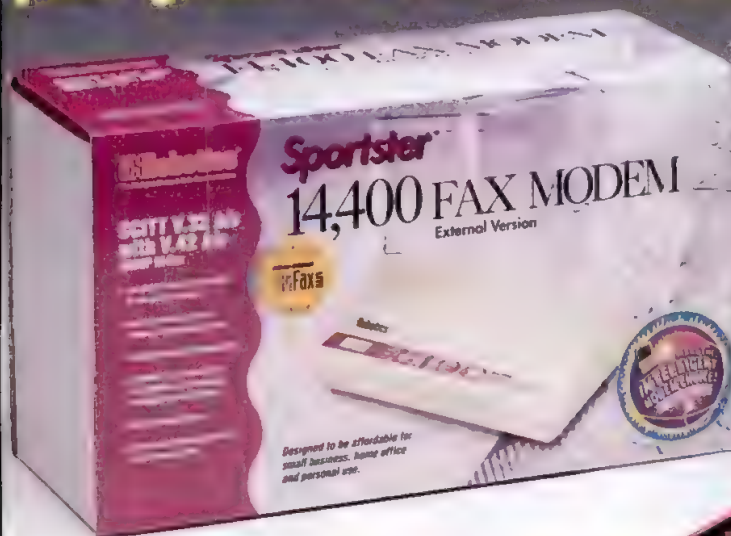
MONITORING FOR KEYS The second interesting portion of the code is responsible for monitoring the hotkeys in the list. When it detects a keystroke that is on the hotkey list, it either starts the associated program or (if the program is already running) switches the main program window to it. The code must also monitor the programs that have been launched, so that it can determine when they are terminated.

Monitoring for hotkeys is not as simple as it might seem. One apparent possibility would be to set a system message hook whose routine would monitor for `WM_CHAR` or `WM_KEYDOWN` messages. Unfortunately, however, this method won't work when the system is in a full-screen DOS box. The solution in HK is again to take advantage of the hotkey function built into Windows 3.1.



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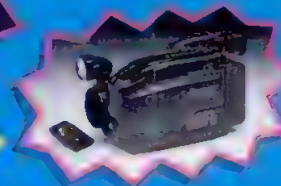
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To do this, HK creates special top-level windows for each hotkey combination it needs to monitor. Once these windows are created, HK sends each of them a WM_SETHOTKEY message, thus assigning each a hotkey. When the user enters a hotkey combination, Windows activates one of these special windows, which then launches its associated application using Windows' WinExec function.

Note that these hotkey windows are top-level windows. That is, they are children of the desktop window, not of the HK main window. As such, they are visible; they must be visible, because the Windows hotkey code will not activate a hidden window. To avoid cluttering the Windows desktop, however, they are positioned beyond the limits of the desktop window.

The hotkey windows created by HK comprise a different class from the HK main window. When HK starts, it registers both the class dealing with the list box and buttons on the main window and a second window class that monitors the hotkey presses. As previously noted, HK creates one of these "hotkey windows" for each hotkey in its list. The only job of the hotkey window is to react to being activated by a hotkey, so it is simpler than a standard window procedure: It does not have to deal with the painting, positioning, or any other user interface tasks. The window procedure for the hotkey window class is shown in Figure 4.

The hotkey window responds to the WM_CREATE message by saving the hotkey code, along with a status word, in a user-defined double word in the window structure. The hotkey code is passed from the HK main window using the lpCreateParams field in the CREATESTRUCT structure to which lParam points. The status word is used by the hotkey window to determine its current state. I'll discuss the use of this state variable shortly.

Before discussing the hotkey window, a brief digression is in order. Note that the values for the hotkey and status data are kept in the user-defined extra bytes in the window structure. It might seem that this information could as easily have been saved in static variables instead of in the window structure. However, static

variables will not work in this case, because there can be more than one hotkey window, and static variables are created on a program-wide basis. More than one hotkey window must be created, but with the static variable approach, the second window would overwrite the data saved by the first window. The only answer, then, is to maintain separate static data for each hotkey window created, and the easiest way to do this is to save the data in the window structure.

A program can make room for user-defined fields when the class is registered. It is very important that the number of bytes reserved in the window structure be kept to a minimum, however, since the space used by Windows for window struc-

***HK's hotkey windows use
a state machine approach,
reacting to messages
differently depending on
the current window state.***

tures is a very limited system resource. Typically, a program should never add more than 4 user-defined bytes to a window structure. If a program needs to store more data than this, Windows should allocate a memory block and use the user-defined bytes to store a pointer to it.

Now to the hotkey window procedure. Since Windows does not explicitly notify a window that it has been activated by a hotkey, the hotkey windows can notice it only by receiving a WM_ACTIVATE message, which is sent to a window when it is about to be activated or deactivated. Thus when a hotkey is pressed, Windows brings the window assigned to the hotkey to the foreground and sends it a WM_ACTIVATE message.

Programmers may wonder why I did not instead make use of the SC_HOTKEY notification in the WM_SYSCOMMAND message. SC_HOTKEY is supposed to notify a window that it is being activated by a hotkey, and it is discussed in the Windows 3.1 SDK documentation. The fact is, however, that even when using a number of available message-monitoring packages,

I was never able to detect Windows in the act of sending this message. Since the SC_HOTKEY notification did not work, I was forced to use the rather inelegant WM_ACTIVATE approach.

Using the more general WM_ACTIVATE message is tricky. The problem is to determine why the message is being sent. Is it because of a hotkey or for another reason, such as that the window has just been created? To determine if the WM_ACTIVATE message is being sent because of a hotkey press, the hotkey window uses a state machine approach. In a state machine, a window—in this case the hotkey window—reacts to messages differently, depending on the current window state. The window state is saved as an integer value in the user data area of the window structure.

A hotkey window can be in one of four states. It is in state 0 while it is created, and it changes into state 1 when Windows sends the initial WM_ACTIVATE message to it just after the window has been created. When the user presses the hotkey and the window is in state 1, the window launches the application using Windows' WinExec call. After starting the application, the hotkey window changes to state 2.

The trick to using the state machine approach is to ensure that the hotkey window gets a WM_ACTIVATE message only when its assigned hotkey combination has been pressed. This is not an easy task. Since the hotkey windows are positioned off the screen, they cannot be activated by a mouse click, but they can be activated when another window on the desktop is minimized. The hotkey window checks for this condition by determining whether a window that has just lost focus was also just minimized. If so, the hotkey window simply sets the focus to the next appropriate window on the desktop.

When the hotkey window successfully launches its application, it receives another WM_ACTIVATE message indicating that it is going to lose focus to the newly launched application. The hotkey window then sends a WM_SETHOTKEY message to the main window of the new application and changes its state to -1. Finally, the hotkey window posts two messages, a MYMSG_HKWINRIP to the HK main window and a WM_

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Resolution	800x600/72Hz 1024x768/60Hz	800x600/72Hz 1024x768/60Hz	1024x768/70Hz	1024x768/70Hz	1024x768/70Hz 1280x1024/60Hz	1280x1024(NI)	640x480/60Hz
Flicker Free	800x600/72Hz	800x600/72Hz	Yes	Yes	Yes	Yes	Yes
Low Radiation	Optional	Optional	Optional	Optional	Yes	Yes	Non Radiation
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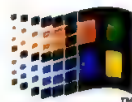
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CLOSE message to itself. When the hotkey window receives the WM_CLOSE message, it is destroyed.

The HK main window responds to the WM_TIMER message by setting a timer to call it back every second. When these WM_TIMER messages are received, the main HK window checks to see whether the application launched by the hotkey window is still running. If the application is no longer running, HK creates a new hotkey window to monitor the hotkey press for that application again.

HK's use of undocumented messages and the treatment of the WM_ACTIVATE message certainly do not illustrate the best programming practice. Undocumented features should always be used with care: In this particular case, though the set and get hotkey messages work fine with Windows 3.1, there is no guarantee that they will work in future releases. The monitoring of the WM_ACTIVATE message is less than desirable Windows programming practice because a program should not depend on the number or sequence of messages being sent to a window. In this instance, problems may result if a future version of Windows sends more than one WM_ACTIVATE message to the hotkey windows when they are created.

I wrote HK using these techniques because I wanted a program with this functionality and, frankly, I could not get it to work any other way. If the documented WM_HOTKEY notification worked as advertised, it would obviate the need to depend on the WM_ACTIVATE message. And the use of the WM_IMEHOTKEY message was driven by my reluctance to delve into the inner workings of Windows' Event Manager code, which is where keys are processed. Why write your own hotkey monitoring routines when Windows already includes one for you?

Programming, like life itself, is a continual series of judgment calls, and how you choose to make them is completely up to you. Leaving aside such deep philosophical considerations, however, HK is a useful program. Install it and your favorite applications will be but a keystroke away. □

DOUGLAS BOLING IS A CONTRIBUTING EDITOR TO PC MAGAZINE.

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Thread Synchronization in Windows NT Programs

BY CHARLES PETZOLD

Multithreading came to desktop operating systems with the introduction of OS/2 1.0 in December 1987. At first, those of us whose programming experience did not include multithreading—and this was almost everyone—were puzzled by this new feature. What sense did it make to have different parts of the same program running concurrently? Eventually, of course, we discovered how some programming problems benefited greatly from multithreaded solutions. But it wasn't until the appearance of the OS/2 Presentation Manager (released in late 1988 with OS/2 1.1) that multithreading provided a real advantage.

I first discussed the principles of using multiple threads of execution in the Presentation Manager in the March 1988 issue of *Microsoft Systems Journal*, at a time when OS/2 1.1 was still in beta. And though our subject in this column is multithreaded programming under Windows NT, it's useful to begin by reviewing those principles.

MULTITHREADING AND OS/2 OS/2 Presentation Manager programs can have multiple threads of execution that run concurrently. These threads are of two types: message-queue threads and non-message-queue threads. Threads in an OS/2 program begin as nonmessage-queue threads. A thread becomes a message-queue thread when it calls the `WinCreateMsgQueue` function and can revert back to a nonmessage-queue thread by calling `WinDestroyMsgQueue`.

Only message-queue threads can create windows, because the window procedure must receive messages to those windows, and those messages come through the message queue. The message queue

created by a thread serves all windows also created by that thread. (That is, a thread cannot create windows whose messages come through another thread's message queue.)

Proper PM programming dictated—and still does under OS/2 2.0 and 2.1—that a message-queue thread not spend a long time processing a message. This resulted from the serialization of user input under the Presentation Manager. In short, PM waits until one window

Two sample programs demonstrate alternate approaches to coordinating multiple threads of execution under Windows NT.

has finished processing a user input message (that is, a message indicating a keyboard or mouse event) before passing the next user input message to the same or another window.

The great majority of window messages result directly or indirectly from user input. If a PM program takes a long time to process a message, it effectively disables the rest of the system. For example, a user can't even switch to another program if one PM program is currently processing a message. Windows that take a long time processing a message usually indicate this by displaying the "wait" icon, which looks like an hourglass under OS/2 1.x and like a clock under OS/2 2.x. In that early *MSJ* article, I discussed the infamous " $\frac{1}{10}$ -second rule": PM window procedures should not take more than $\frac{1}{10}$

second processing any message. Of course, this is a rule that can be (and often is) violated, but this shouldn't happen frequently in a program.

In that early article, I gave the term *big job* to anything a program has to do that violates the $\frac{1}{10}$ -second rule. Obvious big jobs include spell-checking in a word processing program, file sorting or indexing in a database program, spreadsheet recalculating, printing, and even complex drawing. Of course, as we know by now, the best way to follow the $\frac{1}{10}$ -second rule is to farm out big jobs to secondary threads of execution. These secondary threads create neither message queues nor windows and hence are not bound by the $\frac{1}{10}$ -second rule.

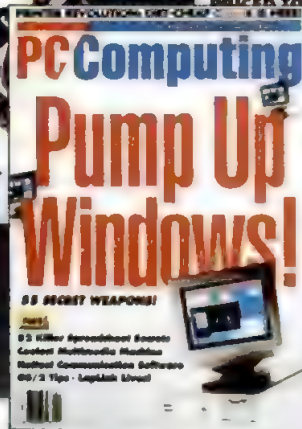
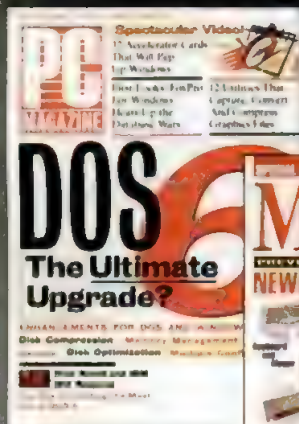
Although some programmers (including myself) experimented with PM programs that had multiple message-queue threads, it soon became obvious that this simply didn't make a whole lot of sense. The approach that made the most sense was for the primary thread to be the *only* message-queue thread, responsible for creating all the windows used in the program and for processing all the messages for those windows. All big jobs could then be farmed out to nonmessage-queue threads.

THE WINDOWS NT DIFFERENCE As you may know by now, Windows NT is a somewhat different animal from the OS/2 Presentation Manager. Windows NT does not maintain a serialized message queue. If a Windows NT program takes a long time processing a message, the user can still switch to another window and get some work done. This might seem to imply that Windows NT programs can safely ignore the $\frac{1}{10}$ -second rule and that they need not farm out big jobs to secondary threads. But this is absolutely not the case.

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BIGJOB1.MAK

Complete Listing

```

#-----
# BIGJOB1.MAK make file
#-----

!include <ntwin32.mak>

bigjob1.exe : bigjob1.obj
    $(link) $(guiflags) -out:bigjob1.exe bigjob1.obj $(guilibsmt)

bigjob1.obj : bigjob1.c
    $(cc) $(cflags) $(cvarsmt) bigjob1.c

```



Figure 1: This is the make file that facilitates the compilation of the BIGJOB1 program.

of thought, I'm convinced that developers should use multithreading to structure their Windows NT programs much as they do OS/2 Presentation Manager programs. Yes, it's possible for a Windows NT user to switch control away from a program doing a big job to get some work done in another program. But this is primarily a *security* feature. The deserialization of user input in Windows NT prevents one program from hanging up the entire system. That's definitely a good thing, but it doesn't really affect how developers should write their programs. In the OS/2 Presentation Manager, if one program goes comatose doing a big job while processing a message, then the entire system goes comatose. In Windows NT, if one program goes comatose, the system can function. But the program doing the big job is still out of commission; it does not respond to user input.

Do you really want to write programs that don't respond to the user? I don't think so. (And I sure don't want to use them!)

So here's how a multithreaded Windows NT program should be structured: The primary thread should create all the program's windows and process messages to those windows. But those windows shouldn't use the primary thread to perform big jobs. The primary thread should be open and receptive to all messages—and quickly processing those messages—to the windows it creates. Big jobs should be farmed out to secondary threads that do not create windows and hence do not receive messages.

Unlike the OS/2 Presentation Manager, in Windows NT there is no real distinction between message-queue threads and nonmessage-queue threads. Every

thread in a Windows NT graphical program has a message queue. But if a Windows NT thread does not create windows, it will not receive messages. In a sense, you can treat secondary threads that don't create windows just as you treat nonmessage-queue threads in OS/2 Presentation Manager programs. But Windows NT has an advantage: OS/2 does not allow a nonmessage-queue thread to send a message (or call any function that results in sending a mes-

***The deserialization of
user input in Windows NT
prevents one program
from hanging up the
entire system.***

sage) to a message-queue thread. Messages must be posted to a message queue rather than sent. Windows NT has no such restriction.

THE BIGJOB1 PROGRAM So now let's adapt a couple of programs for Windows NT that I wrote five years ago for the article about Presentation Manager multithreading. As a hypothetical big job, I'll use a series of floating-point calculations sometimes known as the "savage" benchmark. This calculation increments an integer in a roundabout manner: It squares a number and takes the square root (which cancels out the square), applies log and exp functions (which also cancel each other out), then the atan and tan functions (again canceling each other out), and finally adds 1 to the result.

The BIGJOB1 program is shown in Figures 1 and 2. This is a fairly simple program, but I think you'll see how it illustrates a generalized approach to doing big jobs in a multithreaded Windows NT program. To use the BIGJOB1 program, click with the left mouse button on the client area of the window. This begins 100,000 repetitions of the savage calculation, which will take about 8 seconds on a 33-MHz 386 machine. While the calculation is in progress, you can abort it by clicking on the client area with the right mouse button. The elapsed time is displayed in the window when the calculation is complete.

Let's see how it's done. The window procedure maintains a static variable called *iStatus* that can be set to one of three constants beginning with the prefix *STATUS* that are defined near the top of the program. This variable indicates whether the program is ready to do a calculation, is working on a calculation, or has finished a calculation. The program uses *iStatus* during the *WM_PAINT* message to display an appropriate character string in the center of the client area.

The window procedure also maintains a static structure (of type *PARAMS*, also defined near the top of the program) to share data between the window procedure and the secondary thread. The structure has only two fields: *hwnd*, the handle to the program's window, and *bContinue*, a Boolean variable used to indicate to the thread whether to continue the calculation or not.

When you click on the client area with the left mouse button, the window procedure sets the *iStatus* variable to *STATUS_WORKING* and sets the two fields of the *PARAMS* structure. The *hwnd* field of the structure is set to the window handle, of course, and *bContinue* is set to *TRUE*. The window procedure then calls the *_beginthread* function, which we've encountered in previous columns. This function is included in the C runtime library used for multithreaded programs and is the recommended function for starting up secondary threads. The third parameter to this function can be a pointer to data shared with the thread and, in this case, is a pointer to the *PARAMS* structure.

The secondary thread function is

BIGJOB1.C

Complete Listing

```

/*-----
BIGJOB1.C -- Multithreading Demo
(c) Charles Petzold, 1993
-----*/

#include <windows.h>
#include <math.h>
#include <process.h>

#define REP          100000

#define STATUS_READY    0
#define STATUS_WORKING  1
#define STATUS_DONE     2

#define WM_CALC_DONE    (WM_USER + 0)
#define WM_CALC_ABORTED (WM_USER + 1)

typedef struct
{
    HWND hwnd ;
    BOOL bContinue ;
}
PARAMS, * PPARAMS ;

LONG APIENTRY WndProc (HWND, UINT, DWORD, LONG) ;

int PASCAL WinMain (HANDLE hInstance, HANDLE hPrevInstance,
    LPSTR lpszCmdParam, int nCmdShow)
{
    static char szAppName[] = "BigJob1" ;
    HWND        hwnd ;
    MSG         msg ;
    WNDCLASS    wndclass ;

    wndclass.style      = CS_HREDRAW | CS_VREDRAW ;
    wndclass.lpfnWndProc = WndProc ;
    wndclass.cbClsExtra  = 0 ;
    wndclass.cbWndExtra  = 0 ;
    wndclass.hInstance  = hInstance ;
    wndclass.hIcon       = LoadIcon (NULL, IDI_APPLICATION) ;
    wndclass.hCursor     = LoadCursor (NULL, IDC_ARROW) ;
    wndclass.hbrBackground = GetStockObject (WHITE_BRUSH) ;
    wndclass.lpszMenuName = NULL ;
    wndclass.lpszClassName = szAppName ;

    RegisterClass (&wndclass) ;

    hwnd = CreateWindow (szAppName, "Multitasking Demo",
        WS_OVERLAPPEDWINDOW,
        CW_USEDEFAULT, CW_USEDEFAULT,
        CW_USEDEFAULT, CW_USEDEFAULT,
        NULL, NULL, hInstance, NULL) ;

    ShowWindow (hwnd, nCmdShow) ;
    UpdateWindow (hwnd) ;

    while (GetMessage (&msg, NULL, 0, 0))
    {
        TranslateMessage (&msg) ;
        DispatchMessage (&msg) ;
    }
    return msg.wParam ;
}

void Thread (PPARAMS pparams)
{
    double A = 1.0 ;
    INT     i ;
    LONG    lTime ;

    lTime = GetCurrentTime () ;

    for (i = 0 ; i < REP && pparams->bContinue ; i++)
        A = tan (atan (exp (log (sqrt (A * A)))) + 1.0) ;

    if (i == REP)
    {
        lTime = GetCurrentTime () - lTime ;
        SendMessage (pparams->hwnd, WM_CALC_DONE, 0, lTime) ;
    }
    else
        SendMessage (pparams->hwnd, WM_CALC_ABORTED, 0, 0) ;

    _endthread ;
}

LONG APIENTRY WndProc (HWND hwnd, UINT message, DWORD wParam, LONG lParam)
{
    static char *szMessage [] = { "Ready (left mouse button begins)",
        "Working (right mouse button aborts)",
        "Ad repetitions in %ld msec" } ;

    static INT     iStatus ;
    static LONG    lTime ;
    static PARAMS  params ;
    char          szBuffer [64] ;
    HDC           hdc ;
    PAINTSTRUCT    ps ;
    RECT          rect ;

    switch (message)
    {
        case WM_LBUTTONDOWN:
            if (iStatus == STATUS_WORKING)
            {
                MessageBeep (0) ;
                return 0 ;
            }

            iStatus = STATUS_WORKING ;

            params.hwnd = hwnd ;
            params.bContinue = TRUE ;

            _beginthread (Thread, 0, &params) ;

            InvalidateRect (hwnd, NULL, TRUE) ;
            return 0 ;

        case WM_RBUTTONDOWN:
            params.bContinue = FALSE ;
            return 0 ;

        case WM_CALC_DONE:
            lTime = lParam ;
            iStatus = STATUS_DONE ;
            InvalidateRect (hwnd, NULL, TRUE) ;
            return 0 ;

        case WM_CALC_ABORTED:
            iStatus = STATUS_READY ;
            InvalidateRect (hwnd, NULL, TRUE) ;
            return 0 ;

        case WM_PAINT:
            hdc = BeginPaint (hwnd, &ps) ;

            GetClientRect (hwnd, &rect) ;

            wprintf (szBuffer, szMessage [iStatus], REP, lTime) ;

            DrawText (hdc, szBuffer, -1, &rect,
                DT_SINGLELINE | DT_CENTER | DT_VCENTER) ;

            EndPaint (hwnd, &ps) ;
            return 0 ;

        case WM_DESTROY:
            PostQuitMessage (0) ;
            return 0 ;
    }
    return DefWindowProc (hwnd, message, wParam, lParam) ;
}

```



Figure 2: This is the source code for a program that illustrates creating a second thread for big jobs.

(very unimaginatively) called Thread. It begins by calling `GetCurrentTime` to get the elapsed time in milliseconds that Windows NT has been running. It then enters a `for` loop to do 100,000 repetitions of the savage calculation. Notice that the thread will drop out of the loop if `bContinue` is ever set to `FALSE`.

After the `for` loop, the thread function checks whether it's actually com-

pleted 100,000 calculations. If so, it calls `GetCurrentTime` again to get the elapsed time and then uses `SendMessage` to send the window procedure a program-defined `WM_USER_DONE` message with the elapsed time as `lParam`. If the calculation was aborted prematurely (that is, if the `bContinue` field of the `PARAMS` structure became `FALSE` during the loop), then the thread sends the window

procedure a `WM_USER_ABORTED` message. At this point the thread gracefully ends by calling `_endthread`.

Within the window procedure, the `bContinue` field of the `PARAMS` structure is set to `FALSE` if you click on the client area with the right mouse button. This is how the calculation is aborted before completion.

The window procedure processes the

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BIGJOB2.MAK

Complete Listing

```

#-----
# BIGJOB2.MAK make file
#-----

!include <ntwin32.mak>

bigjob2.exe : bigjob2.obj
    $(link) $(guiflags) -out:bigjob2.exe bigjob2.obj $(guilibsmt)

bigjob2.obj : bigjob2.c
    $(cc) $(cflags) $(cvarsmt) bigjob2.c

```



Figure 3: This make file facilitates the compilation of the BIGJOB2 program.

WM_USER_DONE message by first saving the elapsed time. Processing of both the WM_USER_DONE and the WM_USER_ABORTED messages continues with a call to InvalidateRect to generate a WM_PAINT message and display a new text string in the client area.

That's the general structure of a multithreaded graphical program under Windows NT: The window procedure uses _beginthread to create a thread, most likely passing to the thread a pointer to a structure with variables that must be shared between the window procedure and the thread. The thread reports prog-

ress back to the window procedure using either SendMessage or PostMessage.

It's usually a good idea to include a provision (such as the bContinue field in the structure) to allow the thread to terminate gracefully. The KillThread function should be used only when termination is awkward because threads can allocate resources, such as memory. If this memory is not freed when the thread terminates, then it is still allocated. Threads are not processes; allocated resources are shared among all threads in a process, so they are not automatically freed when the thread terminates. Good

programming structure dictates that a thread should free any resources it allocates.

Note that a third thread may be created while the second thread is still in progress. This could happen if Windows NT switched control from the second thread to the first thread between the SendMessage call and the _endthread call, and the window procedure then created a new thread on response from a mouse click. That's not a problem here, but if it is a problem in one of your own applications, you'll want to use a critical section (described in the previous issue) to avoid thread collisions.

AN ALTERNATE APPROACH BIGJOB1 creates a thread every time it needs to perform the savage calculation; the thread terminates after doing the calculation. An alternative is to keep the thread around for the duration of the program and kick it into action only when necessary. This is an ideal application for a semaphore as BIGJOB2, shown in Figures 3 and 4, demonstrates.

BIGJOB2 uses a type of semaphore known as an event object. I discussed event objects in the last issue, but a brief

BIGJOB2.C

1 of 2

```

/*-----
BIGJOB2.C -- Multithreading Demo
(c) Charles Petzold, 1993
-----*/

#include <windows.h>
#include <math.h>
#include <process.h>

#define REP          100000

#define STATUS_READY    0
#define STATUS_WORKING  1
#define STATUS_DONE     2

#define WM_CALC_DONE    (WM_USER + 0)
#define WM_CALC_ABORTED (WM_USER + 1)

typedef struct
{
    HWND  hwnd ;
    HANDLE hEvent ;
    BOOL  bContinue ;
}
PARAMS, * PPARAMS ;

LONG APIENTRY WndProc (HWND, UINT, DWORD, LONG) ;

int PASCAL WinMain (HANDLE hInstance, HANDLE hPrevInstance,
                    LPSTR lpszCmdParam, int nCmdShow)
{
    static char szAppName[] = "BigJob2" ;
    HWND      hwnd ;
    MSG       msg ;
    WNDCLASS  wndclass ;

    wndclass.style      = CS_HREDRAW | CS_VREDRAW ;
    wndclass.lpfnWndProc = WndProc ;
    wndclass.cbClsExtra  = 0 ;
    wndclass.cbWndExtra  = 0 ;

    wndclass.hInstance  = hInstance ;
    wndclass.hIcon       = LoadIcon (NULL, IDI_APPLICATION) ;
    wndclass.hCursor     = LoadCursor (NULL, IDC_ARROW) ;
    wndclass.hbrBackground = GetStockObject (WHITE_BRUSH) ;
    wndclass.lpszMenuName = NULL ;
    wndclass.lpszClassName = szAppName ;

    RegisterClass (&wndclass) ;

    hwnd = CreateWindow (szAppName, "Multitasking Demo",
                        WS_OVERLAPPEDWINDOW,
                        CW_USEDEFAULT, CW_USEDEFAULT,
                        CW_USEDEFAULT, CW_USEDEFAULT,
                        NULL, NULL, hInstance, NULL) ;

    ShowWindow (hwnd, nCmdShow) ;
    UpdateWindow (hwnd) ;

    while (GetMessage (&msg, NULL, 0, 0))
    {
        TranslateMessage (&msg) ;
        DispatchMessage (&msg) ;
    }
    return msg.wParam ;
}

void Thread (PPARAMS pparams)
{
    double A = 1.0 ;
    INT     i ;
    LONG    lTime ;

    while (TRUE)
    {
        WaitForSingleObject (pparams->hEvent, INFINITE) ;

        lTime = GetCurrentTime () ;

        for (i = 0 ; i < REP && pparams->bContinue ; i++)
            A = tan (atan (exp (log (sqrt (A * A)))) + 1.0 ;
    }
}

```



Figure 4: BIGJOB2.C illustrates triggering a second thread for big jobs.

BIGJOB2.C

2 of 2

```

if (l == REP)
{
    lTime = GetCurrentTime () - lTime ;
    SendMessage (pparams->hwnd, WM_CALC_DONE, 0, lTime) ;
}
else
    SendMessage (pparams->hwnd, WM_CALC_ABORTED, 0, 0) ;
}

_endthread ;
}

LONG APIENTRY WndProc (HWND hwnd, UINT message, DWORD wParam, LONG lParam)

static char *szMessage [] = { "Ready (left mouse button begins)",
                              "Working (right mouse button aborts)",
                              "%d repetitions in %ld msec" } ;

static HANDLE hEvent ;
static INT     iStatus ;
static LONG    lTime ;
static PARAMS pparams ;
char          szBuffer [64] ;
HDC           hdc ;
PAINTSTRUCT   ps ;
RECT          rect ;

switch (message)
{
    case WM_CREATE:
        hEvent = CreateEvent (NULL, FALSE, FALSE, NULL) ;

        pparams.hwnd = hwnd ;
        pparams.hEvent = hEvent ;
        pparams.bContinue = FALSE ;

        _beginthread (Thread, 0, &params) ;

        return 0 ;

    case WM_LBUTTONDOWN:
        if (iStatus == STATUS_WORKING)
        {
            MessageBeep (0) ;
            return 0 ;
        }

```

```

        iStatus = STATUS_WORKING ;

        pparams.bContinue = TRUE ;

        SetEvent (hEvent) ;

        InvalidateRect (hwnd, NULL, TRUE) ;
        return 0 ;

    case WM_RBUTTONDOWN:
        pparams.bContinue = FALSE ;
        return 0 ;

    case WM_CALC_DONE:
        lTime = lParam ;
        iStatus = STATUS_DONE ;
        InvalidateRect (hwnd, NULL, TRUE) ;
        return 0 ;

    case WM_CALC_ABORTED:
        iStatus = STATUS_READY ;
        InvalidateRect (hwnd, NULL, TRUE) ;
        return 0 ;

    case WM_PAINT:
        hdc = BeginPaint (hwnd, &ps) ;

        GetClientRect (hwnd, &rect) ;

        wprintf (szBuffer, szMessage [iStatus], REP, lTime) ;

        DrawText (hdc, szBuffer, -1, &rect,
                  DT_SINGLELINE | DT_CENTER | DT_VCENTER) ;

        EndPaint (hwnd, &ps) ;
        return 0 ;

    case WM_DESTROY:
        PostQuitMessage (0) ;
        return 0 ;
}

return DefWindowProc (hwnd, message, wParam, lParam) ;
}

```

review might help. An event object is either *signaled* or *unsignaled* (known also as *set* or *reset*). You create the event object by calling

```

hEvent = CreateEvent (&sa,
    fManual, fInitial, pszName) ;

```

The first parameter (a pointer to a SECURITY_ATTRIBUTES structure) and the last parameter (an event object name) are meaningful only when event objects are shared among processes. In a single process, these parameters are generally set to NULL. Set the fInitial parameter to TRUE if you want the event object initially signaled and to FALSE if you want it initially unsignaled. I'll describe the fManual parameter shortly.

In order to signal an existing event object, call

```

SetEvent (hEvent) ;

```

To unsignal an event object, call

```

ResetEvent (hEvent) ;

```

A program generally calls

```

WaitForSingleObject (hEvent,
    dwTimeout) ;

```

with the second parameter set to INFINITE. The function returns immediately if the event object is currently signaled (or set). Otherwise the function will suspend the thread until the event object becomes signaled. You can set the second parameter to a time-out value in milliseconds so the function returns before the event object becomes signaled.

If the fManual parameter of the original CreateEvent call is set to FALSE, the event object becomes unsignaled automatically when the WaitForSingleObject function returns. This feature usually makes it unnecessary to use the ResetEvent function.

Now we're equipped to look at BIGJOB2.C. The window procedure pro-

cesses the WM_CREATE message by first creating a nonmanual event object that is initialized in the unsignaled (or reset) state. It then creates the thread. The Thread function enters an infinite while loop but calls WaitForSingleObject at the beginning of the loop. (Notice that the PARAMS structure includes a third field containing the handle to the event object.) Because the event is initially unsignaled, the thread is suspended in the function call. A left mouse button click causes the window procedure to call SetEvent. This releases the second thread from the WaitForSingleObject call, and it begins the savage calculation. After finishing, the thread calls WaitForSingleObject again, but the event object has become unsignaled from the first call. Thus, the thread is suspended until the next mouse click. In other respects, the BIGJOB2 program is almost identical to BIGJOB1. (You can download both of these programs from PC MagNet, archived as BIGJOB.ZIP.) □

Solutions

TIPS AND TECHNIQUES TO INCREASE YOUR PRODUCTIVITY

Peripherals

MEETING DOS-BASED DISPLAY NEEDS

❓ I have an older 386DX/20 system on which I run a variety of DOS applications. While I don't expect to run Windows, I do need to upgrade my Hercules adapter and monitor because I plan to use WordPerfect Presentations, which requires at least a VGA display.

My problem is that I get confused by the seemingly infinite combinations of cards and memory, and by resolution, dot size, and refresh rates. How can I get readable text and numbers in WordPerfect and Quattro Pro, and acceptable performance in Presentations?

*Martin Wolf
Philadelphia, Pennsylvania*

► **PC MAGAZINE:** While WordPerfect and Quattro Pro both have modes that can take advantage of resolutions higher than VGA, we'll assume that 640-by-480 resolution will suffice for your purposes; this is very close to what you're getting now.

The maximum dot pitch for a monitor is determined largely by the resolution you intend to display on it and the size of the screen. Too large a dot pitch produces a grainy image that is hard on the eyes, but too fine a dot pitch does little to improve the image and costs more. Most people agree that a 14-inch monitor with VGA resolutions should have a dot pitch no larger than 0.31 mm. (If you're going to use 800-by-600, the dot pitch shouldn't be greater than 0.28 mm.)

As for the video card, the performance depends mainly on the driver. One advantage of Windows is that you

install the video driver once, then all Windows applications can use it. For DOS programs, you need to install a special driver for each program. It's easier if you stick to a standard resolution like VGA, since most DOS applications come with generic VGA drivers. Such drivers can't take advantage of any of the accelerated features that some Windows accelerator cards offer, such as drawing certain graphic images more rapidly. But if you're dealing with text, you wouldn't gain much using an accelerated video adapter with DOS applications. And these cards aren't the fastest at VGA resolutions; your best bet is a simple VGA adapter with a frame buffer design.

Fortunately, the combination of a good 0.31-dot-pitch VGA monitor and a VGA adapter with a frame buffer design is one of the most affordable color display combinations you can buy. It's not state-of-the-art equipment, but it's likely to fulfill your DOS-based display needs for at least the next two or three years.

—*Alfred Poor*

FANCY LASER PRINTER PAPER

❓ I live on the island of Oahu, just outside of Honolulu. Trying to find different types of laser printer paper is just about impossible, and envelopes are even more scarce. Most companies here offer just a couple of paper styles and no envelopes. Can you help me find a source that would provide a variety of both?

*Michael C. Lusk
Waipahu, Hawaii*

► **PC MAGAZINE:** No need to swim to the mainland, you can get a variety of plain and fancy laser printer papers and envelopes from PaperDirect (205 Chubb Ave., Lyndhurst, NJ 07071-0618; 800-272-7377, 201-507-5488). PaperDirect specializes in laser printer products, including single- and multicolored paper, parchment-type paper, foil papers, and specialized papers for holidays. They also sell matching envelopes.

PaperDirect is also the best source for laser printer paper made from recycled

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See index, page 393.

papers in various grades and textures. A new catalog comes out every three months; call for a copy.—*Joe Salemi*



COPYING DISKS WITH DIFFERENT FORMATS

TIP One annoying chore most computer enthusiasts have endured is copying software from a 3.5-inch floppy disk to a 5.25-inch disk, or vice versa. By using the Windows File Manager, I've been able to achieve almost the same results as DISKCOPY while changing from one format to the other. As long as there is no disk-based copy protection and the amount of data to be transferred is not greater than the target disk can hold, the following solution seems to work.

Open File Manager with two windows—one on the source drive, the other on the target drive. Click and drag the drive letter from the root directory of the source to the drive letter of the target. File Manager will then copy all files and

Douglas Boling is a contributing editor and the author of many utilities, including MBOOT.COM and EMS40 SYS.
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Ethan Winor is a contributing editor and the author of *PC Magazine BASIC Techniques and Utilities*.

subdirectories to the target drive. If your source disk contains more data than the target can hold, File Manager will prompt you to insert a new disk.

*Craig S. Hocevar
Ft. Campbell, Kentucky*

► **PC MAGAZINE:** DOS users can get the same effect using the XCOPY command as follows

```
XCOPY A:\ B:\ /S/E
```

The /S switch tells XCOPY to copy files in all subdirectories of the specified di-

rectory, and the /E switch tells it to copy subdirectories even if they're empty. Unlike File Manager, XCOPY will not prompt for a new disk if the files don't all fit on the target drive.

Note that neither of these techniques truly replaces DISKCOPY, because both require the target disk to be empty. DISKCOPY overwrites the existing contents of the target and will even format the target if necessary. Unless you know in advance that the target is empty, you'll have to format it or otherwise erase all its files before you can fill it with files from the source disk.—*Neil J. Rubenking*

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ADDING INSTALL AND SETUP ICONS IN WINDOWS

TIP I've been running Windows 3.1 for almost a year now, and I'm still adding programs and utilities as well as upgrading a variety of packages. I thought it would be handy to be able to run an Install or Setup program from my floppy disk drives just by clicking an icon rather than having to select Run from the File menu and then typing the command.

First I created a new program group called Install & Setup. To do this, select New from the File menu. Click on the Program Group radio button in the New Program dialog, then click OK. Type "Install & Setup" in the Description text box of the Program Group Properties dialog and click OK.

Next I added four program items to the group: A:Install, A:Setup, B:Install, and B:Setup. To create the A:Install icon, select New from the File menu. Choose the Program Item radio button in the

New Program dialog, then click OK. In the Program Item Properties dialog, type A:\Install for the Description, A:\INSTALL for the Command Line, and A:\ for the Working Directory. Click the Change Icon... push button and assign the icon you like. Return to the Program Item Properties dialog and click OK.

The Program Manager will return an error, "The path A:\INSTALL is invalid," and a warning, "The specified path points to a file that may not be available during later Windows sessions. Do you want to continue?" Just go ahead—you will be able to create the icons.

To add the other items, just follow the same sequence, changing the text as necessary and assigning a suitable icon. Now when it's time to install or set up an application from the A: or B: drive, simply click on the appropriate icon!

David Venzke
Petersburg, Michigan

► **PC MAGAZINE:** Windows does put up a token resistance to the creation of Program Manager items for any files on re-

movable disks, and especially for files on drives that are empty. In addition to the warnings mentioned above, when you initially click on the Change Icon... button, Windows will report that the path A:\INSTALL is invalid.

Windows 3.0 complains even more. If the floppy disk drive is empty, you get a System Error message box three times during the process of creating the floppy disk-based program items. When these boxes appear, you must press Cancel, not Retry, to continue the installation. But once you've overridden Windows' objections, these program items will be very handy!—Neil J. Rubenking

Word Processing

PAINLESS HIGH-ORDER CHARACTERS FOR WINDOWS

► **PC MAGAZINE:** Entering high-order characters—from accented vowels to a

registered trademark symbol—is one of the most common subjects for letters to Solutions. So it's no small matter to find a program that not only provides an elegant approach to entering high-order characters but works for all Windows applications.

The program is called Accent, from pro++Informatique. Because it's shareware, you can try it at no charge. (It is available on CompuServe as ACCENT.ZIP in Library 6 of the Windows Shareware Forum; type GO CIS:WIN-SHARE to get there.) However, the \$25 registration fee is low enough to make price a nonissue in any case. You can order a registered copy by sending a check for \$25 to pro++ Software, 8045 Saguenay, Brossard QC J4X 1N2, Canada.

Accent is a keystroke-translation utility that runs under Windows 3.0 or 3.1 in Standard or Enhanced mode and needs 15K to 30K of RAM. It monitors your keystrokes, intercepts any that you've defined, and translates them as appropriate. Even better, it lets you define just those characters you need and

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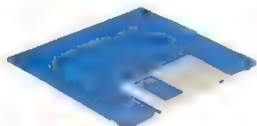
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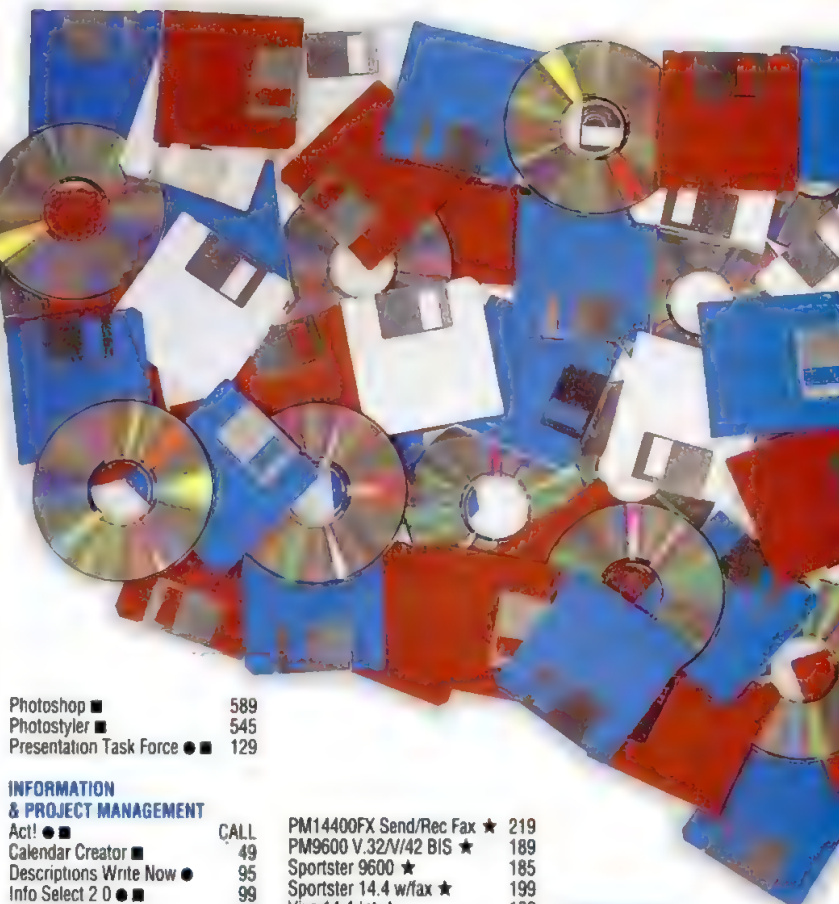
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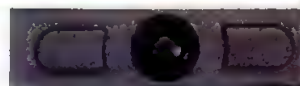
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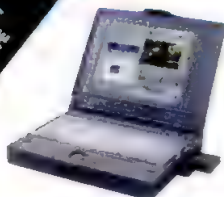
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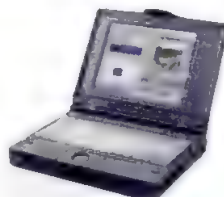


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define them any way you like.

The program offers two approaches to defining keystrokes: You can define an alias that maps a key to any given character, or you can create dead keys—meaning that nothing shows up until you type the *next* character. Type the umlaut dead key, for example, then type a *u*, and you'll get *ü*.

A particularly nice touch is that if you have an enhanced keyboard with two Alt keys, you don't have to tie up any standard typing keys. Instead you can use the right Alt key as a special Shift key. You might use Right Alt-U as the umlaut dead key, for example. Similarly, you could map Right Alt-R as the registered trademark and then type the trademark symbol with a single keystroke.

You'll also find other useful features—including a user-definable hotkey for turning translation on and off. But next to flexibility, Accent's strongest point is invisibility. Once it's set up and set to load automatically with Windows, you can ignore it—as long as you know which keystrokes to type. Like any good utility, it fills its niche so well that you'll quickly conclude it should have been part of Windows in the first place.

One potential problem is that Accent 2.0 assumes you only need one set of definitions, which it stores in the WIN.INI file. If you have more than one user on your system, however, it's at least possible that each user will want to use different keystrokes. Alas, there is no feature for creating additional sets of definitions (although one is planned for Version 2.1). There is a workaround, however.

Accent comes with predefined keyboard files for international choices such as British or Belgian keyboards, and it lets you load any of them as needed. You'll find these files in the directory you designated when you installed Accent; they're named SETxx.INI, where xx indicates the particular file. For example, the British keyboard is SETUK.INI, the Belgian keyboard is SETBE.INI, and so on. Each of these ASCII files takes the same form as the Accent section of the WIN.INI file. To modify any of them, first use the Accent Setup screen to create the definitions and choose Save to store the definitions to WIN.INI.

Next, choose the SETxx.INI file to

modify, open it as an ASCII file in any Windows text editor, and delete everything that follows the line

[Accent 2.0]

Next open WIN.INI, find the Accent section, select everything from the line that starts Acute== to the end of the section, copy it to the Clipboard, and close WIN.INI. Finally, return to the keyboard definition file, paste the contents of the Clipboard right after the [Accent 2.0] line, and save the file as a text file. You'll now be able to load the modified file from within Accent by choosing it from the list of international keyboard files.

—M. David Stone

LEANER WORDPERFECT FILES, WITH LONG NAMES

❗ Martin Schwartz's tip for slimming down bloated WordPerfect files, and your macro for automating the procedure (in the December 8, 1992, Solutions column), both work as promised. However, the macro works only when WordPerfect is set for short filenames. I've tried to modify it to work with the long names and file types available in WordPerfect 5.1, but haven't succeeded, even when I included a [PAUSE] command to stop

and let the user retype the information. Is there a way to make this macro work with long names—preferably with the macro automatically reentering the long name and file type?

David Bowles
Berkeley, California

►PC MAGAZINE: We received several letters asking this question—although, interestingly enough, no one was concerned with any summary information beyond the long name and document type. Keep in mind that the whole point of the original macro was to minimize file size by getting rid of header information. And because the document summary is part of the file header, you'll naturally lose the summary along with the unneeded font information you're trying to get rid of. (See the December 8, 1992, issue for more details.)

The good news is that you can automate the process, at least to the extent of entering the long name automatically and prompting for additional information. Figure 1 shows the modified version of the macro for those who use the long filename option. This version assumes that WordPerfect is set for long display on the List Files screen.

After getting the path and filename for the current file, the macro lists just that file, selects it, and uses the {SYS-

SLIM2.WPM

Complete Listing

```
(;File: get name and path of current file ~
(ACTION)Filename ~ (SYSTEM)Path ~ (SYSTEM)Name ~ ~
(NEW)list current file only, highlighting, and press ~
(Enter) (VARIABLE)Filename ~ (Enter)
(Down) (Down)
(ACTION)LongName ~ (SYSTEM)Entry ~ ~ (Exit)
(;) Close the file, then start a new document (by
entering a single hard carriage return), and
retrieve the original file into the new document ~
(Exit)y(Enter)(Enter)(Enter)y
(Enter)(Retrieve)(VARIABLE)Filename ~ (Enter)
(;) Delete the extra hard carriage return, and save the file ~
(Backspace)(Save)
(VARIABLE)LongName ~
(PROMPT)Enter document type, then hit Enter ~
(Enter) (PAUSE)
(;) Enter must be after Prompt, before pause ~
(Enter) before Prompt, then press and repeat
the prompt line in the text of the Document Type line ~
(Enter)(Retrieve)y(Exit)
(VARIABLE)Filename ~ (Enter)y
```



Figure 1: SLIM2 is similar to the SLIM1 macro shown in the December 8, 1992, issue except that SLIM2 is designed for those who use WordPerfect 5.1's long names feature. As with the original, SLIM2 creates a new file of the same name, retrieving the document into the new file but slimming it down by stripping any unneeded header information.

Word Processing...Spreadsheets

TEM)Entry command to store the name in the variable LongName. When saving the file, it enters the current value of LongName as the name for the new document. Unfortunately, there is no way to read the other document summary information into variables. But you can use the {PROMPT} and {PAUSE} commands, as shown, to have the macro pause and prompt you to enter the information.

As written, the macro will pause at Document Type. And you can, of course, extend this technique to any other fields you normally use (or add {Retrieve}y to retrieve information into the Subject and Abstract fields).

Ultimately, though, if you rely heavily on summary information other than long name and type, you may decide that slimming down your files this way is too much work for more than occasional use.

Note that this version of the macro enters a single hard carriage return in the empty document instead of the space as in the original macro. Entering any character will set WordPerfect to retrieve the old document into the new one, not simply load the old document. But as T.J. Potts (of Rowley, Mass.) pointed out in another letter, if you use a space and you have any of several formatting codes (like a margin code) at the beginning of a document, WordPerfect will add a hard carriage return, so you have two characters to eliminate from the beginning of the file instead of the one that the macro expects. Using the hard carriage return eliminates that minor problem.—*M. David Stone*

Spreadsheets

DATE-ENTRY MACROS FOR 1-2-3, EXCEL, QUATTRO PRO

TIP If you enter a lot of dates into 1-2-3 spreadsheets, the macro in Figure 2 can help. Format a cell to display a date format, then press Alt-D. The macro enters the current date in the cell and presents a menu consisting of +, -, and Esc. Press the Plus key to increment the date by 1, the Minus key to decrement the date by 1, or Esc to accept what's in the cell.

*Steve Mousseau
Alpena, Michigan*

TIP My macros for Excel, Quattro Pro for Windows, and Quattro Pro for DOS (see Figures 3, 4, and 5) are useful for entering dates into spreadsheets. Pressing Ctrl-D (in Quattro Pro for DOS, press Alt-D) enters the current date into the active cell and formats it to display as m/dd. Pressing Ctrl-A or Ctrl-S (Alt-A or Alt-S in Quattro Pro for DOS) adds or subtracts one day to or from the date value. Hold down Ctrl or Alt and lean on the A or S key to step quickly through a range of dates.

*Gary Schrader
San Jose, California*

PC MAGAZINE: Here are two different ways to accomplish the same end. Mr. Mousseau takes the menu-driven approach, while Mr. Schrader favors menuless keyboard commands. Mr. Schrader's macros get the job done a bit quicker, but they require you to remember two additional keyboard codes.

One advantage of Mr. Schrader's technique is that it is more general than Mr. Mousseau's. By holding down Ctrl-A or Alt-A on any numeric cell, you can quickly increment it through a range of numbers. If that cell supplies input to a formula somewhere else, or a graph, this

DATEMAC.WK1

Complete Listing

	A	B	C	D
1	\d	@now~		
2	prompt	{menubrand getchoice}		
3		{edit}{calc}~		
4				
5	getchoice	+	-	<Esc>
6		+ Increase Date	- Decrease Date	Accept Date
7		{edit}{end}+1{calc}~	{edit}{end}-1{calc}~	{edit}{calc}~
8		{branch prompt}	{branch prompt}	



Figure 2: This Lotus 1-2-3 macro enters the date into your current spreadsheet cell and presents you with a menu that lets you increase or decrease the date.

DATEMAC2.XLM

Complete Listing

	A	B
1	\d (d)	=FORMULA("=now()")
2		=FORMAT.NUMBER("m/d")
3		=RETURN()
4		
5		
6	\a (a)	=FORMULA(ACTIVE.CELL()+1)
7		=RETURN()
8		
9	\s (s)	=FORMULA(ACTIVE.CELL()-1)
10		=RETURN()

Figure 3: You can use these Excel macros to enter the date into the current spreadsheet cell and to increase or decrease a date or any other number.

DATEMAC2.WB1

Complete Listing

	A	B
1	\d	{putcell "@now"}
2		/bv~~
3		{Setproperty Numeric_Format,"Short Date Intl.,2"}
4		
5	\a	{let @cellpointer("address"),+@cellpointer("contents")+1}
6		
7	\s	{let @cellpointer("address"),+@cellpointer("contents")-1}

Figure 4: These are the Quattro Pro for Windows equivalents of the macros in Figure 3.

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DATEMAC2.WQ1
Complete Listing

	A	B
1		
2	\d	@now~/ev~/smd5~
3		
4	\a	{let @cellpointer("address"),+@cellpointer("contents")+1}
5		
6	\s	{let @cellpointer("address"),+@cellpointer("contents")-1}

Figure 5: The Quattro Pro for DOS equivalents of the macros in Figure 3.

DATEMAC2.WK1
Complete Listing

	A	B
1		
2	\d	@now~/rv~/rfd5~
3		
4	\a	{let @cellpointer("address"),+@cellpointer("contents")+1}~
5		
6	\s	{let @cellpointer("address"),+@cellpointer("contents")-1}~

Figure 6: This alternative to the macro in Figure 2 dispenses with the menu but requires you to remember its command hotkeys.

can be a quick way of testing the impact of the input in question.

Be careful of applying Mr. Schrader's increment and decrement macros to text cells, however. In Quattro Pro, this mistake will convert the text to a number. In Excel it will earn you a disconcerting error message. If you use these macros a lot, you might want to add a bit of code to trap the potential type mismatch.

In the Quattro Pro versions, add the following as a new first line to both the \A and \S macros:

```
(if @cellpointer("type")<>"v"){quit}
```

In Excel, change the first line of the \A macro to read

```
=IF(ISNUMBER(ACTIVE.CELL()),FORMULA  
(ACTIVE.CELL()+1))
```

Change the first line of the \S macro to

```
=IF(ISNUMBER(ACTIVE.CELL()),FORMULA  
(ACTIVE.CELL()-1))
```

If you're a 1-2-3 user who likes Mr. Mousseau's menu approach, you'll probably want the macro to format the date cell itself. You can do this by changing the first line to

```
@now~/rfd1~
```

Users of any version of 1-2-3 who want to adopt Mr. Schrader's date-entry and increment/decrement macros should use the code in Figure 6. Note the tildes at the ends of the \A and \S lines. Without these tildes you can press Alt-A or Alt-S all day, and 1-2-3 will continue displaying the same number or date—until you press Enter, recalculate the worksheet, or force a screen redraw. In Quattro Pro, the extra tildes are not needed.

You can download all the macros mentioned here from PC MagNet, archived as DATEMA.ZIP.

—Craig Stinson

HIDING RANGES IN 1-2-3 PRINTOUTS

❓ I have a spreadsheet in which I enter data showing the correctness and timeliness of birth certificates each hospital files with the Department of Health.

My interest in the data is to look at how well the hospitals are fulfilling their birth-certificate-filing requirements. I also share this data with the hospitals, but if I give them the whole spreadsheet, they tend to use it only to compare their mar-

ket share of maternity cases, rather than looking at how well they are serving the public. Therefore I like to give each hospital the actual number of certificates for only its facility, while allowing it to compare its performance with that of other facilities.

I cannot believe that Lotus 1-2-3 isn't able to print the worksheet with parts of several ranges blanked out. I can see how businesses and educational institutions would also need such a feature. As it is, I have to use cover-up tape for the columns not meant for all to see, leaving one row completely exposed, then photocopy the printout and snip each column of tape to cover that row and expose the next. I produce these worksheets once a month, and this cut-paste-photocopy routine is a real pain. Please tell me how this can be done in 1-2-3.

Amanda L. Allison
Honolulu, Hawaii

► **PC MAGAZINE:** Put away that white tape. 1-2-3 is very good at hiding sensitive data—on printouts, at least.

If you want your printout to include space for the sensitive columns, apply the Hidden format. Select the top cell of a column that you want to hide, type /Range Format Hidden, then press End, Down, and Enter. After printing, you can restore the prior format by reselecting the top cell, typing /Range Format followed by whatever format is appropriate, and so on. If the column of hidden data originally had your worksheet's default format (that is, if you had never applied a format to the column), restore that default by using /Range Format Reset.

Suppressing data on printouts is one of the few things that the Hidden format is really useful for. On-screen, you can still see a cell's "hidden" data simply by selecting the cell and looking up at the control panel.

If you want the printout to appear as if the sensitive columns don't even exist, hide those columns with the command /Worksheet Column Hide. After you have printed, you can make your hidden columns visible again by means of /Worksheet Column Set-Width or /Worksheet Column Reset-Width. The latter command restores the column to the default column width for your worksheet. You

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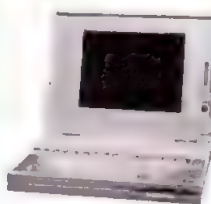
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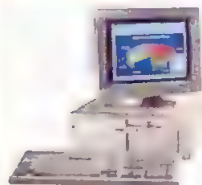


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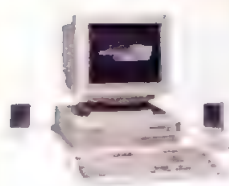
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should use this in preference to /Worksheet Column Set-Width if you've never explicitly assigned a width to the column in question.—*Craig Stinson*

Databases

INCREMENTAL SEARCHING IN FOXPRO

► **PC MAGAZINE:** The help facility in the MS-DOS version of FoxPro demonstrates a feature commonly known as *incremental searching*. When the help window appears, you can type in some keystrokes and FoxPro will position the highlight bar to the first matching topic. For example, to position to the SET topic, you type in S, followed by E, followed by T. FoxPro collects and combines your keystrokes in an internal buffer and after each key, positions the window to the first topic that matches the buffer. Thus, after the S, FoxPro positions to the first topic that starts with S. Then, after the E, FoxPro adds the E to the S and positions to the first topic that starts with SE. Finally, after you press T, FoxPro positions the window to the first topic that matches the buffer, which now contains SET.

If you wait too long between key presses, FoxPro clears its buffer and starts collecting over again. For example,

if you type in S, E, and T in quick succession, FoxPro behaves as I just described. However, if you type in S, wait a second, and then type in E, you'll find yourself positioned at the first topic that begins with E because the delay between keystrokes causes FoxPro to clear its buffer.

This type of incremental search capability is useful because it makes it easy to quickly navigate an ordered list when you're in search of a match.

Custom FoxPro applications often use a Browse window to display a pick list, but FoxPro provides no built-in option to let you provide this type of incremental search facility with your Browse window. You can, of course, write FoxPro code to emulate this feature, but an easier path to incremental searching in a Browse window is found in a shareware offering called jkey.

jkey is a FoxPro add-on library written in C that interfaces to FoxPro using the SET LIBRARY TO command. Once the library is loaded, the library functions can be called just like FoxPro's own built-in functions. The jkey library is designed to provide incremental search capabilities with an active Browse window. Once jkey is activated, it chains into FoxPro's event loop and intercepts all keystrokes, collecting them in an internal buffer. After



Figure 8: The jkey library lets you incrementally search for matching records in a Browse window. You can instruct jkey to show typed keystrokes in a window, as shown above.

a keystroke is placed in the buffer, jkey issues a SEEK command using the contents of the buffer. Thus, FoxPro positions the record pointer to the first matching record and the Browse window is refreshed. If jkey detects no keyboard activity within a certain definable time period, it resets its buffer and the search starts over. In this way, it duplicates FoxPro's own incremental search behavior.

Figure 7 shows a sample program that demonstrates how you can use jkey to incrementally search in a Browse window. First you load the jkey library using the command

```
SET LIBRARY TO jkey
```

After that you initialize jkey using the jkeyinit() function, and then you open the Browse window. Because jkey uses the SEEK command to find matching records, you must be sure to activate the appropriate index prior to initializing jkey. When jkey is active, it intercepts your keystrokes and SEEKS the corresponding record. Your keystrokes can be optionally displayed in a window as you type them (shown in Figure 8). When the Browse is terminated, you call the jkeycanc() function to disable jkey, and then issue the RELEASE LIBRARY jkey command to unload the library. Once the library is unloaded, its functions are no longer available.

You can customize jkey's behavior in a number of ways. For example, the _JEXITKEY memory variable can be used to specify a key that can be used to

JKEYDEMO.PRG

Complete Listing

```
*****
* JKEYDEMO.PRG - Demonstrate use of the JKEY library.
*****
SET ECHO OFF
SET TALK OFF
CLEAR
SET SYSMENU OFF
USE bkinv ORDER title IN 1
USE auth ORDER authid IN 2
SET RELATION TO authid INTO auth
_JEXITKEY = 13          ** Enter terminates the Browse
SET LIBRARY TO jkey
DEFINE WINDOW BROWPICK FROM 5, 6 TO 22, 73 COLOR SCHEME 10
=jkeyinit("U", "", " ")
BROWSE FIELDS title, auth.last, auth.first NOMODIFY NOMENU ;
NOAPPEND NODELETE TITLE 'Books' WINDOW BROWPICK
=jkeycanc()
RELEASE WINDOW BROWPICK
RELEASE LIBRARY jkey
RETURN
```

Figure 7: Sample program that uses the jkey library to incrementally search for matching records in a Browse window.

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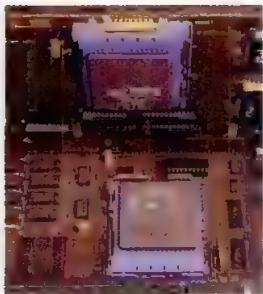
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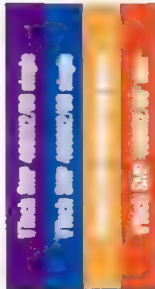
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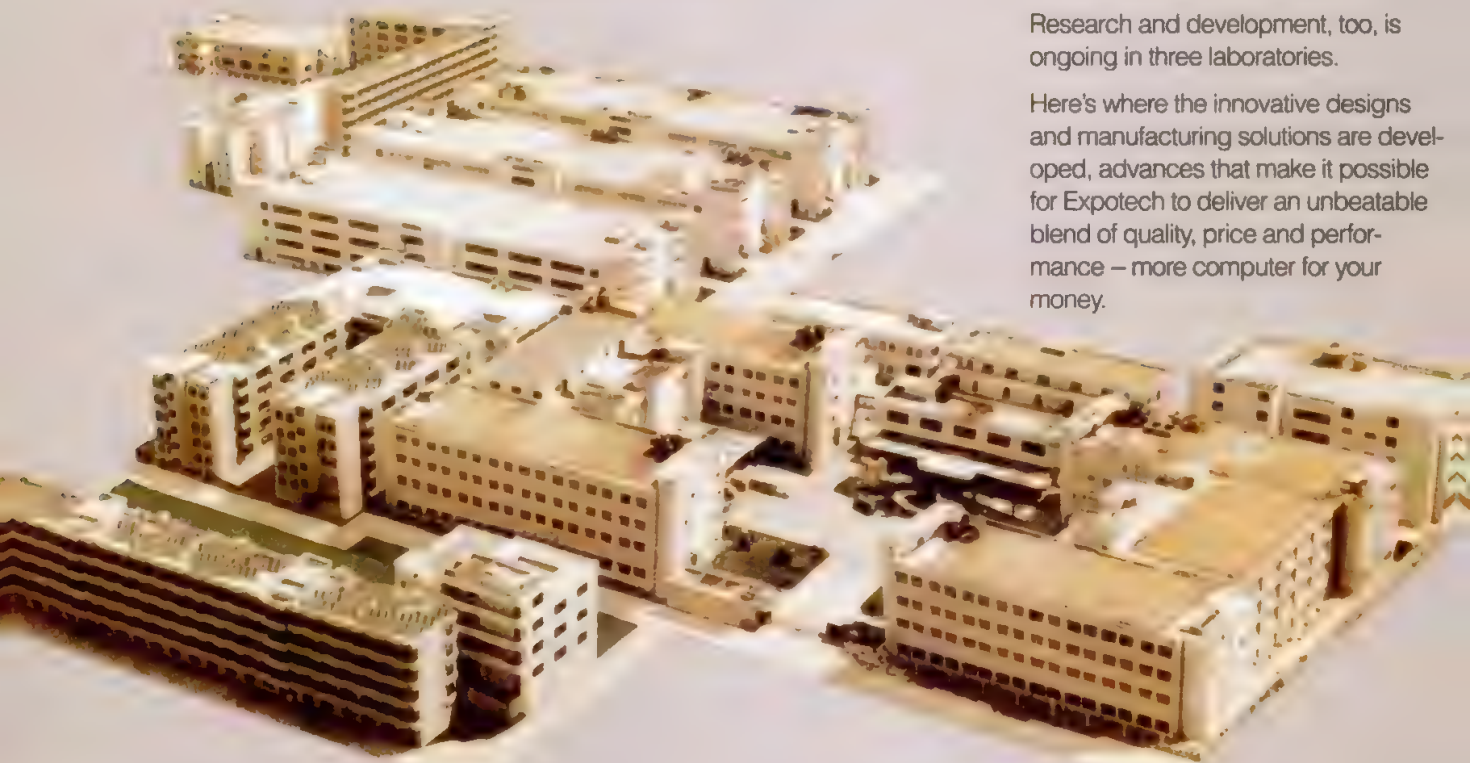
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exit the Browse window. jkey intercepts this keystroke and places a Ctrl-W in the keyboard buffer to close the Browse window. For example, Figure 7 shows how this can be used to make the Enter key terminate the Browse window.

You can also direct jkey's buffer display to a user-defined window instead of the default window, which always appears in the upper-right corner of the main FoxPro window. You can alter the timeout period between keystrokes so that jkey will clear its buffer sooner, or later. By default, jkey uses the value assigned to the _DBLCLICK system memory variable, but you can override it by assigning a value to the _JDBLCLICK memory variable.

jkey can automatically convert keystrokes to uppercase, lowercase, or proper case to match the values stored in your index file. You can also supply a prefix that will be prepended to the buffer before each SEEK is issued.

All in all, jkey makes it a lot easier to add incremental search capabilities to your FoxPro Browse windows. jkey is shareware (\$30 suggested price) and comes with versions for FoxPro 2.5 for MS-DOS, FoxPro 2.5 for Windows, and FoxPro 2.0. You can download it from the FOXFORUM on CompuServe (JKEY25.EXE), or you can get it directly from the author: Joe Gotthelf, 41 Willowbrook Rd., Broomall, PA 19008-1749.

—Sal Ricciardi

Graphics

EXTENDING POWERPOINT'S FONT LIST

TIP Here's a tip for PowerPoint 3.0 users who have a substantial number of fonts installed. In this version of PowerPoint, Microsoft chose to reinvent the font selection process so that only the first 81 fonts (or, in some cases, 96) are available. This occurs because that's all that will fit on the single drop-down menu of available fonts. At first I was stymied because I have several hundred TrueType and Intellifont typefaces installed, and I didn't want to remove any just to create a presentation.

I discovered that if you first choose a font that you *don't* plan to use in your current presentation, you can then use the Replace Fonts command from the Text menu and substitute one font for another. Unlike the Font drop-down list, the Replace Fonts dialog box has a genuine scroll box from which you can easily select your font.

Jim Gunn

Salt Lake City, Utah

► **PC MAGAZINE:** A quick call to tech support at Microsoft confirmed both the problem you describe and the solution you discovered. Microsoft agreed that a single-page drop-down font list is unacceptable in this era of type-mania. You can expect the next version of PowerPoint to use scroll bars for the Font drop-down list—regardless of whether it is accessed from a cascading menu or from the Replace Fonts dialog box.

Currently, the font drop-down is a single-page display that grows in an attempt to accommodate all installed fonts. The drop-down list will literally exceed the dimensions of a standard monitor if you have a sizable number of fonts installed, which means that font names will disappear off the sides and bottom of the display. One disadvantage of a graphical interface is that you can't click on something that you can't see, so you can't select these fonts from the normal Font menu.

The actual number of font names that can be displayed at any one time depends on your current video resolution. The higher the resolution, the more names will fit on the screen. The discrepancies that you see between 81 and 96 available fonts probably represent the difference between VGA and Super VGA video modes.

Although the Replace Fonts feature was originally designed as a way to remap fonts for different output devices, it also provides an alternate method for choosing fonts within the program. For those of you who may never have used the Replace Fonts dialog box, here are a few simple instructions to get you started.

- Type your copy into a slide using a font

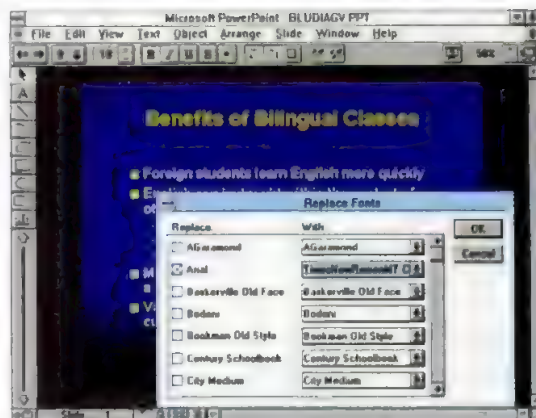


Figure 8: PowerPoint's Replace Fonts dialog box has the ability to scroll through a long list of installed fonts—something that is missing from the Font command itself.

name you can access from the Font drop-down list. Arial, for example, is usually visible because font lists are alphabetized. Be sure to select a font you're not planning to use elsewhere in the presentation.

- Open the Text menu and choose Replace Fonts.
- In the Replace Fonts dialog box (shown in Figure 9), you'll see the name of the "wrong" font on the left side and a drop-down font list box on the right side. This font list, however, is complete with scroll bars that allow you to access any font on your system. As you can see, I chose Times New Roman as the substitute for Arial.
- Click OK to return to the working screen.

All instances of Arial will now be replaced by Times New Roman, or whatever font you choose.

This is a clever way to circumvent PowerPoint's flawed interface, but it is hardly elegant, and it requires that you keep track of each font and its substitute. If you own a substantial number of fonts, chances are that you already have a better solution sitting on your shelf. Many vendors now include font-management utilities along with their typefaces. These utilities let you define font groups—subsets of all available fonts. In turn, font groups can be quickly installed and, for the purpose of cleaning up your font menus, uninstalled.

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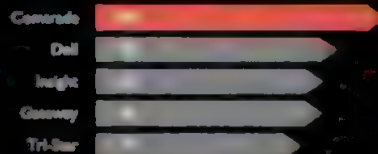
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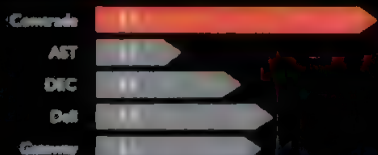
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\$69.95 TrueType FontPack2 includes the Font Assistant utility program (800-426-9400). Typecase and Typecase III—but not Typecase II—from Swfte (800-237-9383) deliver two bonuses for the low price of \$49.95: a font-management utility and the ability to conserve disk space by compressing fonts that are not in use.

I've created various customized font packs using FontMinder from Ares Software Corp. (800-783-2737). This dedicated font-management utility costs \$79.95 and can handle both TrueType and Adobe Type 1 fonts. The product worked flawlessly, and I could easily install or uninstall font packs via FontMinder's drag-and-drop interface. By limiting the number of fonts in each font pack, I had no trouble displaying the fonts I needed for a specific presentation in PowerPoint's single-page drop-down list box.

One final note: Your particular system configuration does contain fonts that will not be so easily managed: printer resident fonts. For people working with PostScript printers, these resident fonts will most likely be the 13 or 35 standard Type 1 fonts—Times, Helvetica, Zapf Dingbats, and company. In your case, the printer resident fonts are the HP Intellifonts built into the HP LaserJet III or IV. Unfortunately, there is only one way to prevent the Intellifont fonts from appearing in PowerPoint's font list: Use the HP Intellifont utility program supplied with your printer to uninstall them.

—Luisa Simone

SIMPLIFYING CGM FILES

❷ I use Harvard Graphics 2.3 and a Bell and Howell film recorder to produce 35-mm color slides. I also use CorelDRAW 2.0 to convert scanned bitmapped files into the Computer Graphics Metafile (CGM) format, which I then import into Harvard Graphics.

My problem is that the CGM files are too complex for Harvard Graphics, and I can't simplify them. Is there a solution?

Steve Fox
Stow, Ohio

► **PC MAGAZINE:** For a totally automatic way to import complex CGM files into a Harvard Graphics presentation, you

have just one option—upgrade. Unfortunately, the version of Harvard Graphics you're using—2.3—has hard-wired limits for imported pictures. For example, no single path or curve can contain more than 200 points. Nor can the CGM file itself exceed a 32K file size (the file size here refers to the size of the file in memory, which is often larger than the size of the file on-disk).

There is some good news: Software Publishing Corp. (408-986-8000) will let you upgrade to either the current DOS or Windows version of the product for only \$125—well below the list price of \$595. Both Harvard Graphics 3.06 and Harvard Graphics for Windows 1.03 allow you to import much more complex CGM files. Both, for example, can handle paths or curves with over 1,000 points.

If upgrading your software is out of the question, be prepared for some manual labor. The only way to get your CGM files into Harvard Graphics 2.3 is to simplify them. I'm not suggesting that you delete important information or remove objects wholesale, just that you learn a bit about the structure of the CGM format and how CorelDRAW exports CGM files. In this case, a little bit of education goes a long way.

Tracing scanned images often results in complex vector files. You can try to reduce the complexity of the final CGM file by lowering the sensitivity of Corel's tracing tools. If you're working with CorelDRAW 2.0's internal autotracing tool, open the Preferences dialog box (found on the Special menu) and set the AutoTrace Tracking to a value between 6 and 10. This will produce a tracing with fewer nodes or points; unfortunately, the result is also a less-precise rendering of the original scanned image.

If you're working with the separate CorelTrace utility, you have more options. For example, you could change the tracing method from Outline to Center line in order to produce simple line drawings (rather than a series of filled objects). You should also experiment with higher settings for the Remove Noise filter to eliminate unnec-

essary details and artifacts introduced during the scanning process. As a last resort, you could reduce the accuracy of the trace by adjusting the Fit Curve and the Sample Rate options.

If fiddling with the tracing parameters doesn't solve your problem, you'll have to edit the image manually in CorelDRAW. Look for the following problem areas:

- Text objects, when they are generated by tracing a scanned image or when you export them from CorelDRAW as a CGM file, are incredibly inefficient. The words that you see on-screen are no longer treated as text; they are just very complex drawings of letters. This is compounded by the fact that the CGM file format does not support multicontoured filled objects. So a drawing of the letter o in a CGM file isn't a single object with a hole in the middle, it's two separate objects. If possible, delete all the words from your drawing and recreate them as true text within Harvard Graphics.
- Gradient fills are not supported by the CGM format. CorelDRAW attempts to compensate for this limitation by simulating the smooth tonal transition of a gradient fill with dozens of little color bands—each of which is a separate object. Replace gradient fills with solid colors.
- Bezier curves are—you guessed it—not supported by the CGM format. So when CorelDRAW exports a picture to the CGM format, it must convert efficient Bezier curves into hundreds of smaller

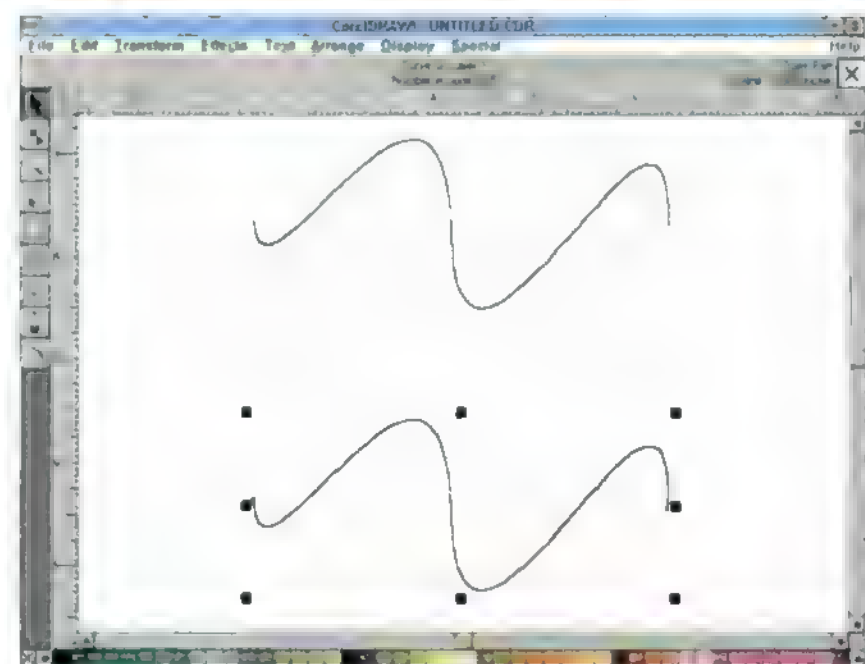


Figure 10: The top curve in this drawing is created with Bezier curves and contains only 3 nodes or points. The curve at the bottom of the screen is the same curve that has been exported to the CGM format. It contains 65 curves. Notice that the status line at the top of the screen provides valuable information about the currently selected object—such as the number of nodes.

Graphics...Networking...Languages

curve and line segments. This can increase the number of points along a line (or path) exponentially. For example, I created a simple curved line in CorelDRAW using 3 Bezier points. But, as shown in Figure 10, the CGM file of the same line contains 65 points. (CorelDRAW always reports on the number of points in a selected object via the status line at the top of the screen.) Carefully analyze your picture and, if you can, manually break long lines into smaller segments. This may keep the objects in your CGM file below Harvard Graphics' limit of 200 points per object.—*Luisa Simone*

Networking

MAKING THE LAPTOP-TO-ETHERNET CONNECTION

❓ I understand there are several ways to connect a laptop to an Ethernet network: an external Ethernet adapter, a docking station with a regular Ethernet card in it, or a laptop with Ethernet on the motherboard. I've read that external adapters are not as fast as a regular Ethernet card installed in the bus. Are there other considerations that should affect my choice?

*Ryan Baker
Tulsa, Oklahoma*

► **PC MAGAZINE:** I doubt you'd notice the difference in throughput offered by these different types of connection devices. With a good server, the response time for an external adapter is still likely to be much better than the response time of the hard drive in your laptop. Note that laptops manufactured with the /XL chip set can implement a technology called the Enhanced Parallel Port (EPP). EPP allows the parallel port to pass data in bursts of a couple of megabits per second. External LAN adapters from Xircom, D-Link, Kingston, Megahertz, and others can work with EPP.

Docking stations seem to be universally expensive. Technically, the throughput should be better than an external adapter, but again I doubt you'd notice. Adapters on the motherboard should be the fastest of all. ZDS is in this market and others will be in the next few months.

Toshiba has offered adapters that use the modem slot for years.

I suggest you also look into Artisoft's Central Station. This product is a unique "connectivity processor" that will act as an external LAN adapter, a print server, and a remote control device for the network when you are on the road.

Whatever you choose, don't forget to consider compatibility. If you plan to use TCP/IP or VINES or some other networking software, it's important to check the compatibility of the LAN adapter first.—*Frank J. Derfler, Jr.*

USING MODEMS IN EUROPE

❓ On a recent trip to Europe, I had to perform surgery on my hotel telephone in order to make a modem connection. I was finally able to connect at 2,400 bps, but it still didn't work very well. Any suggestions for making modem connections in Europe?

*Tom Horton
Atlanta, Georgia*

► **PC MAGAZINE:** First I'd like to solicit tips from road warriors carrying modems around the world. Please drop me a fax, e-mail, or note telling me what you found in your travels and how you overcame obstacles. I know what is supposed to be out there, but there often seems to be a difference between what the official telecommunications agencies say and what travelers actually find in their hotels.

Some of the problems you face are simply mechanical. For instance, there are about 35 different types of telephone jacks in use around the world if you include variations like the old Swiss 3-prong and the new Swiss 4-prong. But some of the challenges are more arcane. Several countries, for example, put intermittent pulse tones on the local loop from the central office to trigger metering equipment in the customer's premise. These tones might be optional and they might be filtered by a PBX, but they also might interrupt your modem.

The safest connection you can make is through your telephone handset using an acoustical coupler—the \$149 Konexx Koupler (619-277-3300) is your best bet. I've tried others, but I prefer the Konexx for connections to public telephones, cel-

lular telephones, and other instruments without RJ-11 jacks.

However, I've found a British company that equips travelers for any environment in the world. Teleadapt offers every telephone connector ever made, connector kits, filters, and many other devices that help you make connections in faraway places. Contact Teleadapt at 29A Bridge St., Pinner, Middlesex HA5 3HR, U.K. (telephone 1-44-081-429-0479). You can also reach the company on CompuServe; the account is 100111,2713.—*Frank J. Derfler, Jr.*

Languages

OPTIMIZE BASIC'S RESUME STATEMENT

✓ **TIP** While compiling a program with Microsoft BASIC, I discovered that how I coded ON ERROR...RESUME made a large difference in the memory used by the BC.EXE compiler. If I use RESUME with a line label or line number, BC requires the /E switch and reports that its workspace has 9,769 bytes free while compiling. However, if I use RESUME NEXT or RESUME with no line label, the /X switch must be used, which leaves 0 bytes free. It appears that BASIC has to work harder when /X is used, and by simply adding a reference line as the RESUME target, I was able to compile a program that was too large otherwise.

*John Thomas Smith
Vancouver, Washington*

► **PC MAGAZINE:** If a runtime error occurs while ON ERROR is active, BASIC jumps directly to the code you specified as the error handler. At the end of the error-handling code, the RESUME command returns execution to the main program. There are three ways to use RESUME: with a line number or label, by itself, or with NEXT. If you use RESUME with a line label or line number, BASIC simply jumps to the statement at the specified line. When you use RESUME alone, you are telling BASIC to jump to the statement that caused the error and to try to execute it again. Similarly, using RESUME NEXT means you

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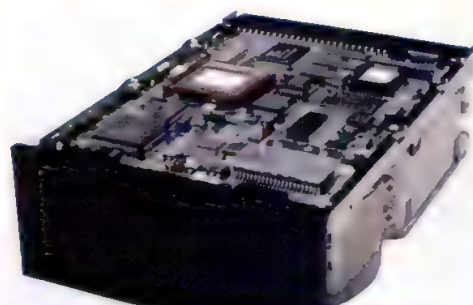
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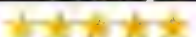
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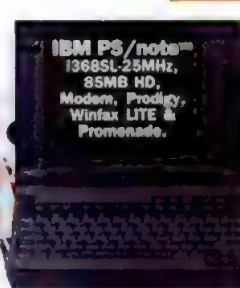


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want to jump to the statement after the line that caused the error. Unfortunately, it is not a simple task for BASIC to determine the address of the machine code that corresponds to the current or next statement.

Each BASIC source statement is converted by the BC compiler to a series of machine code (assembly language) commands. Some BASIC statements can be represented using only one equivalent assembler command. For example, $X\% = X\% + 1$ can be translated to `INC WORD PTR [X%]`. But many BASIC statements, including calls to routines in the BASIC runtime library, result in several assembly language commands. When an error occurs, there is no way for BASIC to determine directly the starting address of the series of machine code statements that corresponds to the current or next BASIC statement.

Therefore, when you specify the `/X` compiler switch in order to allow the use of `RESUME` alone or `RESUME NEXT`, BASIC must keep track of the starting address for every group of assembler commands that represents each BASIC statement. This requires BASIC to manage more information as it compiles your program, which requires additional memory. Further, the table of starting addresses is also added to the final `.EXE` file, increasing its size.

When `RESUME` alone is executed, BASIC scans through this address table, comparing each entry to the address of the assembly command that was current in the main program at the time the error occurred. When it finds an address higher than the current address (that is, the error address) it knows it went too far and uses the previous table entry as the jump target. And when `RESUME NEXT` is used, BASIC scans the table looking for the first address higher than the current address. Again, most BASIC statements compile to a series of assembly language commands (each beginning at a different address), so it is not possible to resume a command in the middle of the series (where it may have encountered the error).

In some cases it is not possible to avoid `RESUME` alone or `RESUME NEXT`. But if it is possible to add logic to your error handler to resume at a fixed line,

the efficiency of your programs will definitely improve.—*Ethan Winer*

Communications

UPGRADING YOUR UART

❓ I want to install a 14,400-bps fax/modem in my 486/33, but I think I'll need to upgrade the UART. Which UART should I install to run at 14,400? Will I need to upgrade anything else?

*Lanny Marcus
Sherman, Texas*

► **PC MAGAZINE:** In order to get the best performance from today's high-speed modems, you need a connection between your computer and the modem that's at least four times the maximum speed of the modem. This means that the PC should talk to a 14,400-bps (V.32bis) modem at 57,600 bps. However, the 8250 or 16450 UARTs (universal asynchronous receiver-transmitters) that control the serial ports on most systems today can't reliably handle that speed. These UARTs were designed for slower computers and modems and can't buffer the incoming data and service the hardware interrupts fast enough to prevent data loss.

The 16550AFN UART is designed to handle high-speed communications; it has a 16-byte internal data buffer that holds the incoming data while it services the system interrupts. A 16550AFN can reliably handle 57,600 bps or higher data rates with no data loss.

If you plan to use an internal modem, you're in luck. An internal modem is actually a combination modem and serial-port card. Most modem vendors include the 16550AFN UART on their internal high-speed modems, so you have nothing else to buy. Just make sure the modem you're purchasing has this UART chip. Once you install it, set your communication program's speed to 57,600 bps for all the dialing directory entries and you're all set. By setting your program's speed to this rate, you're ensuring that you'll get the best possible throughput regardless of the actual connection speed between your modem and the remote modem.

However, if you decide to buy an external modem, you'll have to upgrade

your system's UARTs to get the maximum performance from the modem. Unfortunately, with the exception of the current IBM PS/2s that come with 16550AFNs already installed, most systems sold today come with an 8250 or 16450 UART soldered onto the motherboard. In order to upgrade the UART, you have to disable one or more of the internal serial ports and purchase a separate serial-port board that either comes with a 16550AFN, or has the UART chip mounted in a socket so it can be replaced.

The most common high-performance serial-port board is the Hayes ESP board (Hayes Microcomputer Products, P.O. Box 105203, Atlanta GA 30348; 404-441-1238), which has two serial ports with two 16550s. The ESP board lists for \$299 and can be purchased at most computer supply stores.

You won't need any other hardware, but if you're using Windows, you may want to improve its built-in comm port driver to get better communications performance while running multiple programs. The driver that comes with Windows 3.1 has limited support for the 16550AFN; the one that comes with Windows 3.0 has none. The Hayes ESP board includes new drivers for both Windows and OS/2. For other systems with the 16550AFN, the TurboCom driver from Bio-Engineering Research Laboratories (180 Beacon Hill Lane, Ashland, OR 97520; 503-482-2744) is a good choice. This \$47.50 driver enables all the special features of the 16550AFN UART for both Windows communications programs and DOS communications programs running under Windows (which the built-in driver doesn't do). TurboCom supports speeds up to 115,200 bps.

Another alternative is the KingCOM for Windows driver from OTC Corp. (17300 17th St., Suite J-117, Tustin, CA 92680; 714-832-4833; \$49.95). The KingCOM driver lets you run both Windows fax software and communications software at the same time by using Windows' multitasking capabilities to provide up to nine virtualized comm ports. Version 1.0 was reviewed in the July 1993 issue of *PC Magazine*; Version 1.1, which will add 16550AFN support, should be available by the time you read this.

—*Joe Salemi* □

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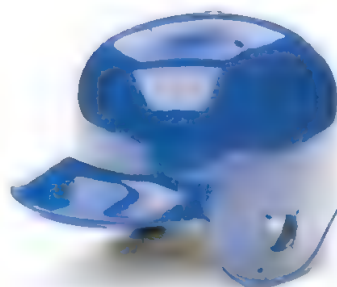
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Elite 486SLC-33 Notebooks

MidWest Micro

Elite 486SLC-33 Subnotebooks

When The Game Goes Into Extra Innings, You'll Be Glad You Have An Elite

Not only do the Elite 486SLC-33 Color and Monochrome Notebooks give you more computing power, they give you the power to compute longer. Use the SUSPEND/RESUME feature to avoid unnecessary system rebooting and compute up to 6 hours on a single charge*.

For those afternoon games, the Elite provides a large, non-glare VGA screen that eliminates distortion, flickering and eye strain so you can compute comfortably. Text and graphics appear at 640 x 480 resolution in 64 gray shades or 256 colors.

And if you get caught up in the action, a quick glance at the LCD panel lets you know which drives are being accessed, when battery power is low, what function keys are enabled, whether external power is being used and if there is a modem ring. With the Elite's LCD panel, you'll never feel like you're out in left field.



Elite 486SLC-33 Color

Model	Item #	Price
80 Mb	005461	\$1699
120 Mb	005466	\$1769
200 Mb	005471	\$1889

Elite 486SLC-33 Monochrome

Model	Item #	Price
80 Mb	005446	\$1209
120 Mb	005451	\$1279
200 Mb	005456	\$1399

Statistics:

Processor:

Cyrix 486SLC

Processing Speed:

33 MHz

RAM:

2 Mb RAM, expands to 8 Mb

Hard Drive:

80 Mb, 120 Mb or 200 Mb

Floppy Drive:

Built-in 1.44 Mb 3.5"

Screen:

Color - 9", 256 colors

Monochrome - 10", 64 gray shades

Video RAM:

Color - 512K

Monochrome - 256K

Keyboard:

83 key with 101-key emulation

2-button thumbball mouse

Weight:

Color - 5.7 lbs. with battery

Monochrome - 5.4 lbs. with battery

Battery Life*:

Color - 4 hours

Monochrome - 6 hours

640 x 480 resolution

Simultaneous video

Advanced Power Management

One parallel and one serial interface

External VGA monitor and

keyboard connectors

FREE AC adapter carrying case and

MS-DOS 6.0 installed

One-year manufacturer's warranty

Take Me Out To The Ball Game

Compact and lightweight, the 486SLC-33 fits you like a glove. It weighs only 3.7 lbs. and measures 10" x 7" x 1.6", but is more advanced than notebooks twice its size. The Elite 486SLC-33 Subnote comes with a 33 MHz Cyrix processor and 2 Mb of RAM. Need grand slam power? Add an easy-to-install RAM upgrade or take advantage of the latest technology with the Subnote's Type II PCMCIA

interface. It allows you to install PCMCIA cards for flash memory, modems and network adapters.

You'll never run out of storage space with the Elite Subnote. Once you fill its 80 Mb or 120Mb removable hard drive, simply take it out and insert another hard drive. There's no limit to the number of hard drives you can fill...or files you can save.



You'd think a small sub notebook would be hard to work on—but it's not. The Elite Subnote rounds out its bases with a 7.4" high-contrast screen that displays 640 x 480 VGA resolution and 64 gray shades.

Elite 486SLC-33 Subnote

Model	Item #	Price
80 Mb	005415	\$1359
120 Mb	005416	\$1449

Statistics:

Processor:

Cyrix 486SLC

Processing Speed:

33 MHz

RAM:

2 Mb RAM, expands to 8 Mb

Hard Drive:

Removable 80 Mb or 120 Mb hard drive

Screen:

7.4" high-contrast screen

640 x 480 VGA resolution

64 gray shades

Video RAM:

256K

Weight:

3.7 lbs. with battery

Size:

10" x 7" x 1.6"

Battery:

Nickel metal hydride battery

Up to eight hours with APM*

Keyboard:

79-key with 101-key emulation

Built-in 2-button trackball

Drag button

Interfaces and Ports:

Parallel and serial interfaces

External keyboard, monitor and

modem connectors

External floppy port

PCMCIA Type II slot

Advanced Power Management

Simultaneous video

FREE external 3.5" 1.44 Mb floppy drive,

AC adapter and utilities support disk

FREE MS-DOS 6.0 installed

One-year manufacturer's warranty



*Battery life measured with Power Management enabled. Actual battery life may vary.



Elite 486SX/DX Notebooks

Elite 486SX-25 Subnote

With 27 Notebooks to choose from, everyone is a player.

Everyone loves our new line of Elite 486 Notebooks. Choose your Elite with an Intel 486SX-25, 486DX-33 or 486DX2-50 processor, select an active color, dual-scan color or monochrome screen and then pick the hard drive that best meets your needs—from 80 Mb up to 200 Mb!

No matter which processor, screen or hard drive you choose, your Elite 486 Notebook comes standard with 4 Mb of RAM and can be upgraded to 20 Mb.

Isn't it a relief to know that whether you're a teacher, doctor, lawyer, sales representative, student or homemaker, there's an Elite 486 Notebook perfectly matched to your needs...and your budget?

Statistics:

Processor:
Intel 486SX-25, 486DX-33 or 486DX2-50
RAM:
4 Mb, expands to 20 Mb
Hard Drive:
80 Mb, 120 Mb or 200 Mb
Screen:
10", 640 x 480 VGA resolution
Backlit display
Color - 256 colors
Monochrome - 64 gray shades
Battery Life*:
Active Color - 3 hours
Dual-Scan Color - 4 hours
Monochrome - 6 hours

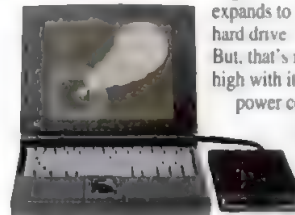
Weight:

Color - 6.9 lbs.
Monochrome - 6.4 lbs.
512K Video RAM
86 keys with 101-key emulation
Built-in trackball
Built-in 1.44 Mb, 3.5" floppy drive
Advanced Power Management
One parallel and one serial port
External VGA and keyboard connectors
**One PCMCIA Type III slot/
two Type II slots**
FREE AC adapter and utilities disk
FREE MS-DOS 6.0 installed



The Best In The Field...

If you're looking for a powerful portable, the Elite 486SX-25 Subnote is a great catch. Weighing a mere 3.9 lbs., the 486SX-25 Subnote features a large 10" VGA screen, 4 Mb of RAM that expands to 12 Mb and up to a 200 Mb hard drive.



But, that's not all! The Elite Subnote scores high with its special Intel processor for low power consumption, Advanced Power Management and PCMCIA Type II slot for modems, flash memory, network adapters and more.

All this for under \$1500? Only at MidWest Micro—so call us today and get your Elite Subnote for peanuts.

486SX-25 Subnote

Model	Item #	Price
80 Mb	005575	\$1499
120 Mb	005576	\$1549
200 Mb	005577	\$1639



Statistics:

Processor:
Intel 486SX
Processing Speed:
25 Mhz
RAM:
4 Mb expands to 12 Mb
Hard Drive:
80 Mb, 120 Mb or 200 Mb
Screen:
10", 640 x 480 VGA resolution
Backlit display
64 gray shades

Battery Life*:

5 hours
Weight:
3.9 lbs.
512K Video RAM
83 keys with 101-key emulation
Built-in trackball
External 1.44 Mb, 3.5" floppy drive
Advanced Power Management
One parallel and one serial port
External VGA and keyboard connectors
One PCMCIA Type II slot
FREE AC adapter
FREE MS-DOS 6.0 installed

486SX-25 Elite Notebooks

	Monochrome	Dual-Scan Color	Active Color
80 Mb	\$1599 #005500	\$2339 #005505	\$3219 #005510
120 Mb	\$1649 #005501	\$2389 #005506	\$3269 #005511
200 Mb	\$1739 #005502	\$2489 #005507	\$3369 #005512

486DX-33 Elite Notebooks

	Monochrome	Dual-Scan Color	Active Color
80 Mb	\$1869 #005515	\$2599 #005520	\$3489 #005525
120 Mb	\$1919 #005516	\$2659 #005521	\$3539 #005526
200 Mb	\$1999 #005517	\$2749 #005522	\$3629 #005527

486DX2-50 Elite Notebooks

	Monochrome	Dual-Scan Color	Active Color
80 Mb	\$2089 #005530	\$2839 #005535	\$3719 #005540
120 Mb	\$2139 #005531	\$2889 #005536	\$3759 #005541
200 Mb	\$2239 #005532	\$2979 #005537	\$3859 #005542

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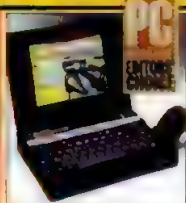


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120MB **\$2584.16** CDW 27678

TM4000 WinDX2™/40 Color

- i486DX2/40 Microprocessor (Coprocessor Included) ● 4MB RAM
- 9.5" Diagonal Passive Matrix LCD, 256 Simultaneous Colors, 512KB Video Ram ● 640 x 480 Display
- Simultaneous External Display ● Pre-Installed MS-DOS V6.0 Windows V3.1 TI Utilities
- Weighs Only 6.3 lbs ● 1 Year Warranty

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TM4000 WinDX/25 Monochrome

- i486DX25 Microprocessor (coprocessor included) ● 640 x 480 Display, 10" Diagonal ● 64 Gray Scales, 1MB Video RAM ● Simultaneous External Display
- 4 MB RAM ● Pre-Installed MS-DOS V6.0, Windows V3.1 TI Utilities ● Weighs 5.6 lbs
- 1 Year Warranty

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TM4000 WinSX/25 Monochrome

- i4863X/25 Microprocessor
- 4 MB RAM ● 640 x 480 Display, 10" Diagonal ● 64 Gray Scales, 1MB Video RAM ● Simultaneous External Display ● Pre-Installed MS-DOS V6.0, Windows V3.1 TI Utilities ● Weighs 5.6 lbs
- 1 Year Warranty

120 MB **\$1895.48** CDW 23164

TM4000 TravelMate™ WinDX2™/50 Monochrome

- i486DX2/50MHz Processor
- 640 x 480 VGA Display (9.4")
- Pre-Installed Windows 3.1
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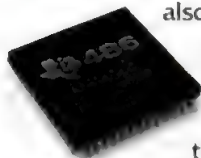
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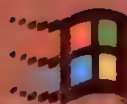
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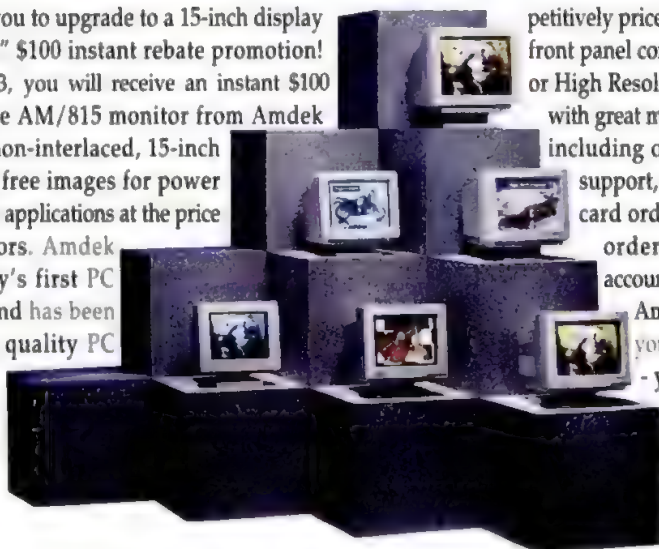
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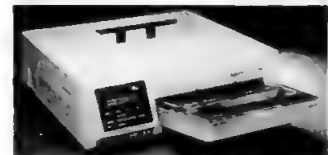
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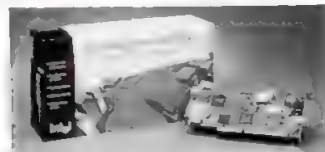
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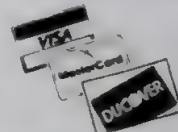
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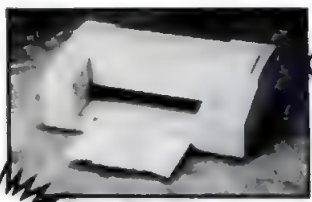
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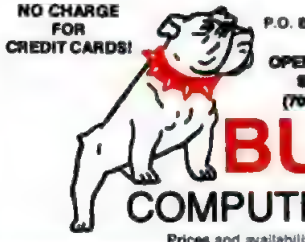
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400	14F7291	5319	14M00	90F7291	597
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PS/2 35X, LS 4052, PS/1 Consultant X-series					
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440D	D2151A or D2154A		\$259
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Hydra 404/25H; 404/33H; 404/50H; 404/66H			
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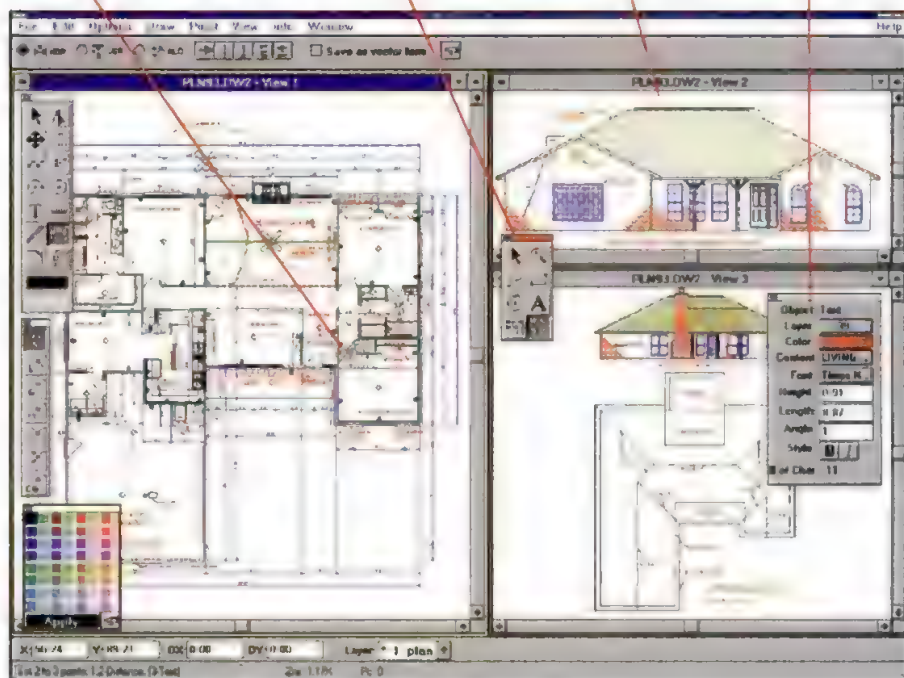
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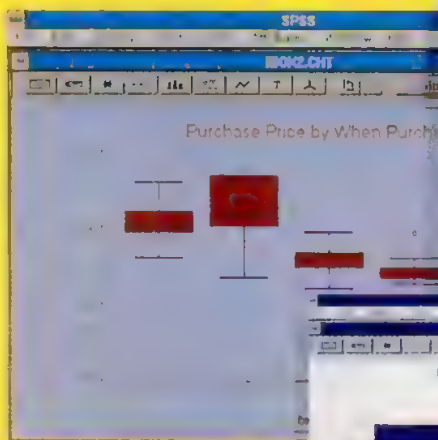
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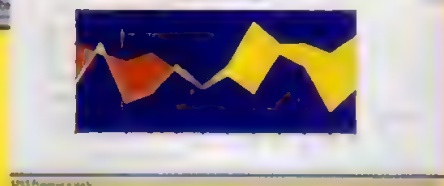
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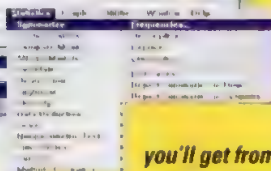
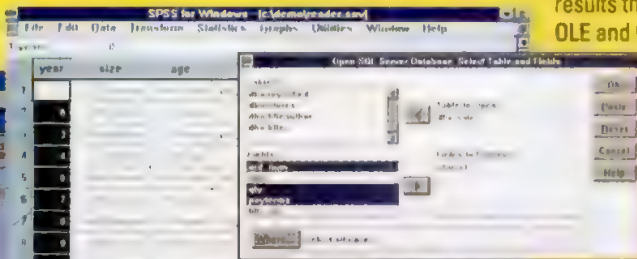
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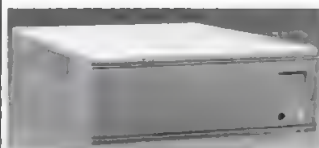
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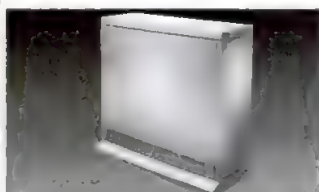
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ST1587N	525	3.5	14	\$ 809
ST3600N	525	1"	111	\$ 738
ST4766N	565	1"	12	\$ 875
ST4767N	665	1"	12	\$ 908
ST1980N	860	3.5	10	\$ 853
ST41200N	1037	1"	15	\$ 949
ST11200N	1050	3.5	11	\$ 902
ST41600N	1370	1"	12	\$ 1501
ST41650N	1415	1"	15	\$ 1714
ST11950N	1700	3.5	8	CALL
ST42100N	1900	1"	13	\$ 1400
ST12550N	2145	3.5	9	\$ 2252
ST12400N	2100	3.5	9	\$ 1818
ST42400N	2186	1"	10	\$ 1786
ST43400N	2912	1"	10	\$ 2262
IDE				
ST3096A	80	1"	16	\$ 158
ST3144A	130	1"	16	\$ 169
ST3243A	212	1"	12	\$ 202
ST3283A	245	1"	12	\$ 276
ST3290A	260	1"	16	\$ 239
ST3390A	341	1"	12	\$ 274
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72455	245	1"	15	\$ 257
73455	340	1"	15	\$ 347
LXT540SY	540	3.5	8.5	\$ 812
12405	1240	3.5	8.5	\$ 1095
PD175H	1400	1"	13	\$ 1145
IDE				
7131A	130	1"	15	\$ 175
7213A	213	1"	15	\$ 210
7245A	245	1"	15	\$ 228
7345A	340	1"	14	\$ 299
540A	540	3.5	8.5	\$ 733

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TYPE	MB	SIZE	SEEK	PRICE
EL5170S-A	170	1"	17	\$ 190
LP5240S-A	240	1"	16	\$ 243
LP5525S-A	525	1"	10	\$ 683
PD1050S	1050	3.5	10	\$ 889
PD1225S	1225	3.5	10	\$ 1005

WESTERN DIGITAL

TYPE	MB	SIZE	SEEK	PRICE
WD2200	200	3.5	14	\$ 210
WD2240	245	3.5	14	\$ 238
WD2340	340	3.5	13	\$ 297

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TYPE	MB	SIZE	SEEK	PRICE
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1624	667	1"	14	\$ 610
2108	698	3.5	10	\$ 980
2112	1050	3.5	10	\$ 913
1598	1034	1"	14	\$ 1166
1528	1345	1"	14	\$ 1166
1908	1321	1"	11.5	CALL
2217	1750	3.5	8	CALL
1924	2100	1"	11.5	\$ 1786
1936	3050	1"	12	\$ 2262
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2112A	1035	3.5	10	\$ 913

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M2624FA	520	3.5	12	\$ 610
M2266S	1079	1"	14	\$ 1124
M2694	1080	3.5	10	\$ 908
M2652S	1750	1"	11	\$ 1789
M2654S	2061	1"	11	\$ 1600
IDE				
M2624T	520	3.5	12	\$ 678

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TYPE	MB	SIZE	SEEK	PRICE
SCSI				
DSP3105	1050	3.5	9.5	\$ 980
DSP3160	1660	3.5	10	\$ 1270
DSP5200	2000	1"	12.5	\$ 1781
DSP5350	3500	1"	11.5	\$ 2450

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CP30174	170	1"	17	\$ 189
CP30204	212	1"	12	\$ 225
CP30254	245	1"	14	\$ 229
CP30544	540	3.5	12	\$ 638
SCSI				
CP30170	170	1"	17	\$ 202
CP30200	212	1"	12	\$ 274
CP30540	540	1"	10	\$ 656
CP3370	1370	1"	10	\$ 1019

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EXABYTE	8505	560	BMM	\$ 2250
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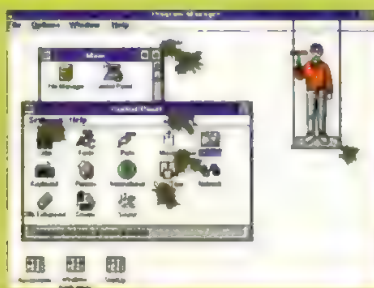
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Gates Does Windows	GDW.ZIP	This Windows 3.1 screensaver with sound features Microsoft CEO Bill Gates moonlighting as a window-washer.	After Hours Forum Library 4
Project Event Planner	APLANR.ZIP	Helpful Windows program for quick project planning, activity or resource scheduling. Shifts all events forward/backward in time.	PBS APPS Library 5
Starfire	STARFI.ZIP	Action-packed, arcade-quality "shoot 'em up." Battle an evil alien race that has set out to destroy earth.	PBS ARCADE Library 3
WinZip	WINZIP.ZIP	Windows Zip file manager for use with PKZip.	PBS APPS Library 4
HomePlan	HOMEPL.ZIP	Easy-to-use program to design a floor plan for your house.	PBS APPS Library 8
Secrets of Credit Repair	CREDIT.ZIP	Tips, tools and hints for repairing your credit bureau reports.	PBS APPS Library 6
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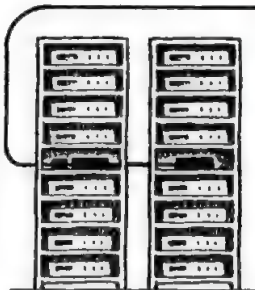
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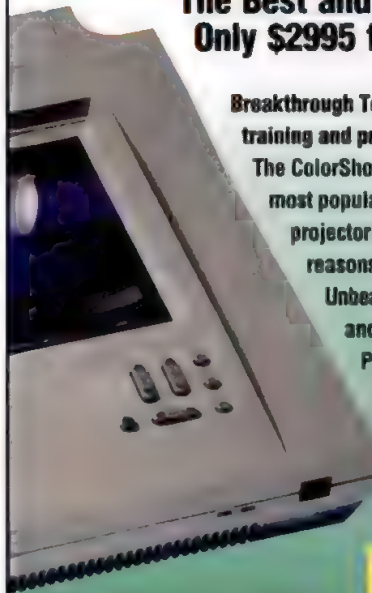
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COMMUNICATIONS-COMPUTER SYSTEMS-INPUT/OUTPUT DEVICES/BAR CODING

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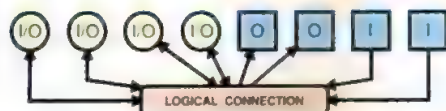
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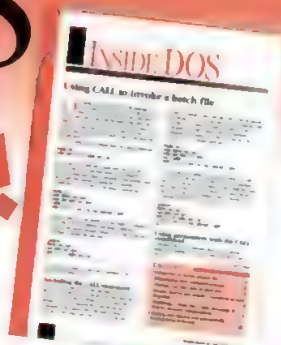
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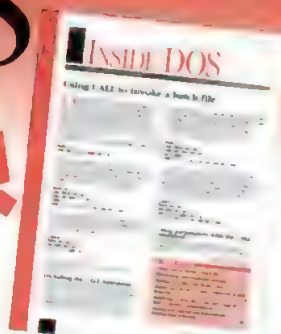
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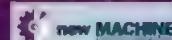
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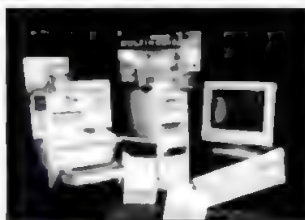
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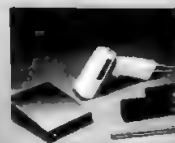
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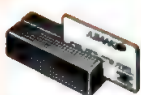
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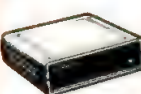
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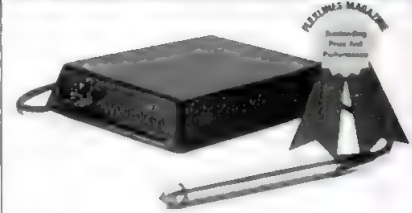
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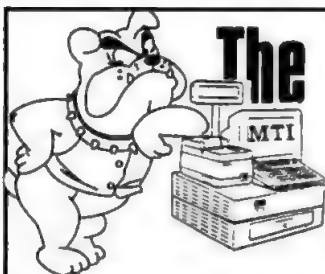
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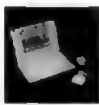
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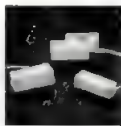
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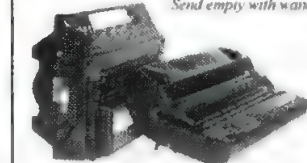
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- 02. ☐ Linked to mini
- 03. ☐ Networked together

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- 03. ☐ IBM or Compatible Minis
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- 05. ☐ CD-ROM
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8. Do you plan to buy any PC products?

- 01. ☐ Now 03. ☐ In 7 to 12 months
- 02. ☐ In 4 to 6 months 04. ☐ No definite plans

9. Number of employees in your entire company:

- 01. ☐ 25 or less 03. ☐ 100-499 05. ☐ 1000 or more
- 02. ☐ 26-99 04. ☐ 500-999

Name

Title

Company Name

Address

City

Telephone

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01. ☐ Yes 02. ☐ No

2. Please indicate your company or organization's primary business activity: (Check one)

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03. ☐ Manufacturer-Other
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11. ☐ Research and Development
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4. Is your company a reseller?
01. ☐ Yes 02. ☐ No

5. For how many IBM PCs and compatibles do you specify brands of products:

01. ☐ 10 or less 03. ☐ 26-99
02. ☐ 11-25 04. ☐ 100 or more

6. Are there any PCs in your office?

01. ☐ Linked to mainframe
02. ☐ Linked to mini
03. ☐ Networked together

7. Please check the equipment currently installed at your location: (Check all that apply)

01. ☐ IBM or Compatible PCs
02. ☐ IBM or Compatible Mainframes
03. ☐ IBM or Compatible Minis
04. ☐ Macintosh
05. ☐ CD-ROM
06. ☐ Windows

8. Do you plan to buy any PC products?

01. ☐ Now 03. ☐ In 7 to 12 months
02. ☐ In 4 to 6 months 04. ☐ No definite plans

9. Number of employees in your entire company:

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Title

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Coming Up

Multimedia's Coming of Age?

CD-ROM drives and sound cards are becoming more common in home and workplace personal computers, but are most systems ready to face the challenge of true multimedia? *PC Magazine* tests 45 systems from companies like Compaq, Dell, and IBM to find out which combine superior PC performance with quality audio reproduction.

High-End Accounting

Today's multiuser, multimodule, LAN-based accounting packages are breaking new ground in performance, interface quality, ease of use, and customization capabilities. And the best of the crop are bringing to market powerful features that compete with established minicomputer-based accounting software. *PC Magazine* tests 11 of today's top LAN accounting systems—a mix of established market leaders and vigorous new blood—and takes an advance look at the radical next generation of GUI client/server apps.

Network Operating Systems

Choosing an NOS seems like part luck, part mysticism. Some call it a gamble. But if you've seriously assessed your current and future networking needs, we'll give you some recommendations to guide you from there. We review how seven multiserver NOSs deliver in terms of distributed naming services, expandability, wide area connections, multiprotocol support, Mac and Unix support, print services, management, and performance.

Free Utility

If you sometimes have trouble remembering phone numbers, turn them into snappy phrases with FONEWORD, a Windows 3.1 utility that finds the mnemonic words and phrases that can be made from any given seven-digit telephone number. Written in Microsoft Visual Basic 3.0, FONEWORD creates an exhaustive list containing all of the possible word-plus-number combinations (8-DOLLAR) as well as perfect "vanity numbers" (BIG-SHOT) that consist only of actual words.

Breaking the Language Barrier

Like a digital Tower of Babel, application support for all the world's languages is difficult and problematic. Windows NT, however, features a new character representation called Unicode that eases the problem of multiple language support. Join *Environments* columnist Charles Petzold for an in-depth look at how you can implement Unicode in your applications.

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After Hours

RELIGION: Logos Bible Software 1.6 Dual Version; Quick Verse; The New Bible Library; The CD-ROM Judaic Classics Library; Torah Scholar Plus Rashi

RELIGION

Five Scripture Titles Offer Spiritual Well-Being

BY J.W. OLSEN

Not long ago, studying Scripture meant possessing a printed copy of the Bible or equivalent writings for your faith. Comparing translations required you to buy multiple versions. Concordances, topical and word studies, commentaries, maps, and other research and historical works meant additional purchases, and scholars of the Christian tradition stocked their bookshelves with original Greek and Hebrew texts, too.

No more! Bible study has been made easier with a variety of easy-to-manage, easy-to-navigate software products—including one to suit almost anyone's needs and resources. In this roundup, we evaluate three titles in the Christian tradition (Protestant and Catholic) and two in the Judaic tradition.

One of the best features of a computer-based Bible is the ability to search and make comparative studies. No longer do you need scribble notes in margins or try to coordinate reams of paper with corresponding references. The Bibles we review here make these undertakings easier, less space-intensive, and less expensive than ever.

Whether you prefer the DOS or Microsoft Windows

environment and whether or not your system includes a CD-ROM drive, a hard disk, or only floppy drives, we offer something for you. Each provides more reference material than you are likely to own now. Even if you own a thorough religious library, you will find a product here to enhance the speed, convenience, and effectiveness of your studies.

LOGOS RESEARCH SYSTEMS

Logos Bible Software 1.6 Dual Version

Logos Bible Software is the product against which other Christian software titles have been judged. Because of the exceptional ease with which features can be accessed through Logos's Windows interface, it remains a top contender for the serious student of the Scriptures.

The latest version is available in three basic releases, each of which readily accepts Logos Research Systems' add-in modules. Logos Bible Software 1.6 (\$129) ships with the King James Version of the Bible (minus the Apocrypha), Strong's numbering (a leading referencing system), an enhanced dictionary that expands on those references, and The Treasury of Scripture Knowledge, which features more than 500,000 cross-references. Logos Bible Software

1.6 Dual Version, provided for this review, includes all of the above plus the New International Version—or any one of four alternative biblical versions. The third release, Logos Bible Software 1.6 Dual Catholic Version (\$129), offers the complete New American and New Jerusalem Bibles.

LAYERED COMPLEXITY

The Windows interface encourages effortless, serious exploration of biblical nuances: The printed manual isn't essential to jump into your studies. Logos calls this approach "layered complexity." New users may immediately use the product much as they would a printed book and gradually learn to use its additional features.

From one pull-down menu, for example, experienced users might turn on Strong's numbering system, pop up translator notes and user-created notes for the current passage, and display cross-references or associated references in The Treasury of Scripture Knowledge at the same time.

Searching is quick and thorough, in large part because the index is highly optimized and a hefty 20MB is installed directly on the hard disk. (That requirement may be a serious purchasing consideration.)

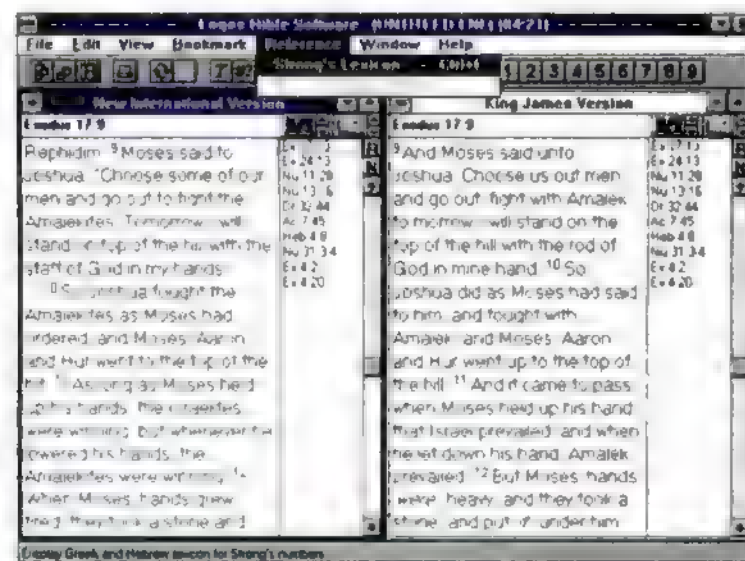
Logos Bible Software takes

advantage of Windows' Dynamic Data Exchange, allowing you to import a range of verses into a Windows word processor, desktop publishing program, or database.

EASY ADD-INS

This package offers a vast assortment of add-in modules, which integrate easily into the above releases. There are seven alternative English, four Greek, and two Hebrew Bibles. Each features scalable fonts for the respective language.

Other add-ins include the well-known Nave's Topical Bible, historical works and commentaries, and biblical grammar tools. The last module is a noteworthy asset



Layered complexity: Logos Bible Software lets novices start quickly and ease into the advanced features.

compared with what competitors offer. Spanish, Dutch, and French modules are available, too. Add-ins range from \$15 to \$119 and require one of the three basic releases.

Logos Bible Software 1.6 deserves serious consideration if you can afford to dedicate the necessary hard disk space and want speedy, powerful search capabilities.

Logos

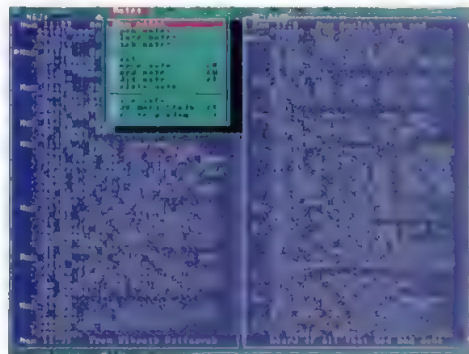
Logos Bible Software 1.6 Dual Version, \$159. Requires: 2MB RAM, Windows 3.x, 20MB hard disk space. Logos Research Systems Inc., 2117 200th Ave. West, Oak Harbor, WA 98277; 800-875-6467, 206-679-6575; fax, 206-675-8169. Circle 446 on reader service card

PARSONS TECHNOLOGY

QuickVerse

Befitting the customary focus of its product portfolio, Parsons Technology aims QuickVerse at the mass market while maintaining a high level of value for moderately serious students of Christianity.

QuickVerse comes in both



Versatile footnotes: QuickVerse provides many options for making, cutting, pasting, and displaying notes.

a DOS version (Version 2.0, \$69) and a Windows version (Version 1.0, \$79) and ships with one of six translations of the Protestant Bible. The DOS package sent to us provides more capabilities than the casual user is likely to use, yet demands modest system resources—just 512K RAM and 3MB of hard disk space.

As with most DOS-based products, the initial learning curve is a bit steeper than for Windows alternatives. But getting up to speed isn't all that challenging, especially with a mouse installed.

For instance, to keep the

program fairly easy to use, Parsons chose to limit some of the product's search options—but that's typically one of the greatest assets of Scripture software. This simplicity may be a virtue, but serious scholars will find it limiting.

To its credit, the search engine does feature some handy touches; for example, you can scan within or across indices. The package also displays up and down icons after an initial search. Clicking on one moves to the preceding or subsequent occurrence of the search term without making you invoke a menu or dialog box.

You may also tag notes to specific words or verses, generate multiple footnote files, cut and paste between them,

and automatically display or print them.

Version 2.0 adds user-defined topical indices and lets users view multiple translations and original meanings in Hebrew (Old Testament) or Greek (New Testament) simulta-

neously, if you have purchased those add-ins.

There is one small glitch, however. Several items that require add-ins appear on the menu, and invoke error messages when those modules are not present. While Logos Bible Software graciously grays out such menu items, Parsons' approach leads to frustration until you learn which features you can access.

Like Logos, Parsons offers many related add-in modules. These include Bible Illustrator, PC Bible Atlas, GreekTools, HebrewTools, Nave's Topical Bible, a Hebrew &

Greek Transliterated Bible, and six separate versions of the Protestant Bible: King James, New King James, New International, Revised Standard, New Revised Standard, and Living Bible. Each add-in sells for \$39 to \$69.

With its straightforward presentation and choice of options, QuickVerse will be welcome in the home of any Protestant family.

QuickVerse, Version 2.0, \$69. Requires: 512K RAM, DOS 2.11, 3MB hard disk space per translation. Parsons Technology, One Parsons Dr., Hiawatha, IA 52233-0100; 800-223-6925, 310-395-9626; fax, 319-395-0217.

Circle 447 on reader service card

ELLIS ENTERPRISES INC.

The New Bible Library

If you have a CD-ROM drive and \$495 to spare, The New Bible Library, from Ellis Enterprises, offers more material than any disk-based product, with unique advantages to Protestant and Catholic users.

In a single, well-coordinated and ready-to-go package, you receive a mind-boggling 16 versions of the Bible (one with Apocrypha), seven word studies (including the prominent Strong's Hebrew and Greek dictionaries), four commentaries, three sets of cross-references, four reference and historical works, eight topical studies (including Nave's Topical Bible, five sets of sermon outlines containing 500 texts each, and 101 hymn stories), and 12 maps

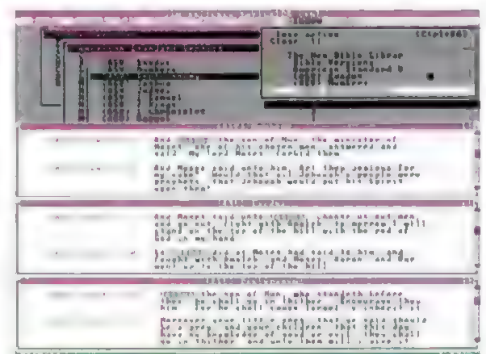
with companion texts. The five sermon outline modules cover almost any audience: Basic Bible Truths, Children's Sermons, On The Christian Life, Evangelistic Sermons, and Gospel Sermons.

Though DOS-based, the front-end system (IBM's Navigator) has a remarkably Windows-like feel, and installation demands less than 1MB of hard disk space.

The CD-ROM format offers advantages and disadvantages. Its strengths are the ease of installation, the amount and diversity of information, and the frugal hard disk requirement. The weakness, at least for those who plan to use this product extensively, is the relative sluggishness with which text is retrieved.

The speed of text retrieval is a complaint that can't be lodged against the publisher; improvement must await now-emerging advances in CD-ROM technology. Double-speed CD-ROM drives, for instance, offer a notable edge.

Nonetheless, before getting used to the product, I wondered if I had failed to in-



Dense text: The New Bible Library contains 16 versions of the Bible and dozens of additional works.

voke a search properly before an item eventually appeared. The number of matches found in searches—sometimes only one-quarter as many as in Logos or QuickVerse—was disappointing.

New Bible Library

MOST REFERENCE MATERIAL

The sheer volume of material in The New Bible Library also presents advantages and disadvantages. The fact that it offers the most reference material is a clear advantage for many users. But wading through this material—even with the commendably inviting and intuitive front-end software—is a challenge the user must learn to address in order to take full advantage of the data.

A more thorough and somewhat easier-to-use search facility would be a welcome enhancement, and would place The New Bible Library far ahead of its competitors.

On balance, The New Bible Library is a wise investment if you demand comprehensive reference material without reserving a large amount of hard disk space, and if you can be patient during searches.

The New Bible Library, \$495. Requires: 640K RAM, DOS 5.0, 1MB hard disk space, CD-ROM drive. Ellis Enterprises Inc., 4205 McAuley Blvd., #385, Oklahoma City, OK 73120; 800-729-9500, 405-749-0273; fax, 405-751-5168.

Circle 448 on reader service card

DAVKA CORP.

The CD ROM Judaic Classics Library, Second Edition

The content of Davka's CD-ROM Judaic Classics Library is to Judaism what Logos Bible Software is to Christianity. In an informal survey, Davka's product was consistently identified as the title against which its competitors are judged.

Further, it is held in high es-

teem by the Orthodox Jewish community, and is the product of choice for serious Christian scholars studying original texts. Note, however, that you must be well-versed in Hebrew in order to use this product, as English menus and on-line help are unavailable.

This ambitious CD-ROM provides browsing, searching, and viewing of Tanach, Babylonian Talmud, Aggadic Midrashim, Mishneh Torah, Rashi on Chumash and Talmud, Zohar, Talmud Yerushalmi, four Torah commentaries, and more—a commendably thorough set of writings. You may save selected material to a file or print it, but this DOS product leaves you to your own resources—including a Hebrew-aware word processor and Hebrew fonts—to work with the character set. (Our informal survey suggested that most potential users of this product already have these capabilities.)

POWERFUL SEARCHING

Searching is fast and powerful. You may turn off suffixes and prefixes, specify up to eight simultaneous search terms, use basic Boolean operators, and set a permissible number of words between multiple search terms.

The extensive source material and substantial search capabilities justify the \$269 cost, but we have some significant objections to some of the program's features: namely, a copy-protection dongle (a hardware device that thankfully went out of vogue years ago) and some important changes made to your hard



Hebrew text: Judaic Classics Library is remarkably comprehensive for students with knowledge of Hebrew.

disk's root directory upon installation that are not mentioned in the manual.

Most notably, the installation program adds a line to your AUTOEXEC.BAT file, which in turn loads a 5K TSR into memory, then returns your system to the DOS prompt. The undocumented TSR, which substitutes Hebrew characters for some upper-ASCII codes, does not announce itself when run.

This little change causes problems if your AUTOEXEC.BAT invokes Windows or a shell without returning control to the DOS command line. Under such circumstances the TSR is not loaded, and later attempts to execute Judaic Classics Library result in screens displaying neither English nor Hebrew but upper ASCII. On the other hand, if the TSR does load, it can conflict with apps that need access to the upper-ASCII characters.

Further, the TSR presumes 25-line video mode—not a safe assumption. In 50-line VGA mode, only half of the lines of DOS displays are visible. The manual is also silent about removing the TSR.

Finally, the user interface is weak by contemporary standards, and no Windows version is available.

Despite some of its annoy-

ances, The CD ROM Judaic Classics Library is worth serious consideration by the scholar who demands maximum access to Judaic documents and for whom raw reference material is the overriding factor. For even more text, a third edition recently became available. The \$549 CD-ROM contains all of the text found in the second edition, plus additional codes of Jewish law and more Halachic writings.

The CD-ROM Judaic Classics Library, Second Edition, \$269. Requires: 640K RAM, DOS 3.3 or later, 2MB hard disk space, CD-ROM drive. Davka Corp., 7074 N. Western Ave., Chicago, IL 60645; 800-621-8227, 312-465-4070; fax, 312-262-9298.

Circle 449 on reader service card

TORAH EDUCATIONAL SOFTWARE INC.

Torah Scholar Plus Rashi 1.0n

Torah Scholar Plus Rashi targets Jewish families with some knowledge of Hebrew, and is available as a variety of stand-alone products. Torah Scholar provides the Chumash (the first five books of the Old Testament) in both English and Hebrew for \$179. Torah Scholar Plus Rashi (\$219), sent to us for review, includes the Chumash with hypertext links to the Rashi commentary. Currently, Rashi is in Hebrew, but an upgrade will soon add the English translation.

Additional products include Bible Scholar Hebrew, which adds the rest of the Tanach (the vast body of work related to the Old Testament), and Bible Scholar English, which features an English rather than Hebrew concordance and is intended to reach the Christian market as well.

Torah Scholar

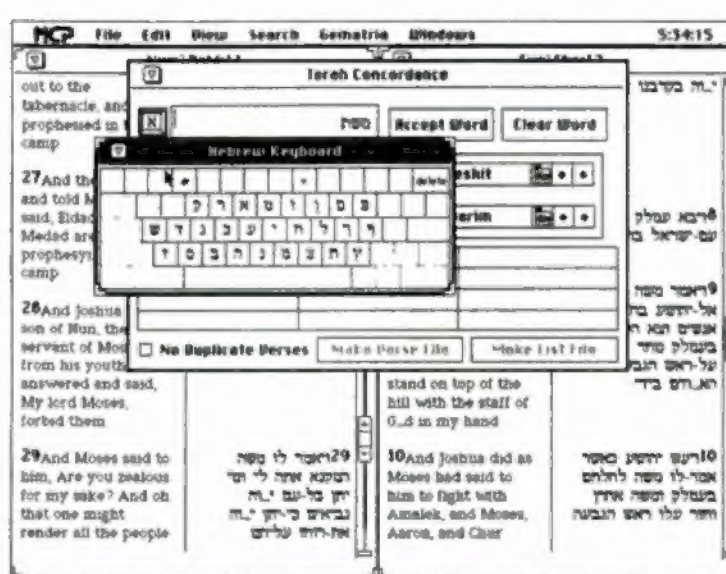
Because all titles in this product line are hard disk-based, they predictably encompass less reference material than Judaic Classics Library. But for many users, this coverage may suffice.

Some time is needed to become comfortable with the DOS-based program's interface, and a Microsoft-compatible mouse is a necessity. The pull-down menus and general methodology in accessing features operate in mildly unexpected ways, but most users will find them adequate if they can live with the black-on-white display.

We found the modest search and display features rather slow for a hard disk-based product. On the positive side, however, it is possible to perform searches in English or

Hebrew. To make the Hebrew searches easier, the program pops up a graphical display to remind you which key corresponds to a particular Hebrew character. In addition, this package (like the Judaic Classics Library) comes with stick-on labels for your keyboard. Unlike the more expensive Davka product, Torah Scholar prints text and graphics on most popular printers. Devices that emulate Epson dot matrix, LaserJet, DeskJet, and PostScript printers are accommodated.

We were pleased to find that Torah Scholar does not require a TSR or other special steps to run. Simply execute the main program for automatic access to all display and printing services. Exit Torah



Convenient pop-up: Torah Scholar's Hebrew keyboard pops up and makes word searches easier.

Scholar and your system immediately returns to its original state.

Like Judaic Classics Library, Torah Scholar employs copy protection: in this instance a software lock, which will prevent most users from running the program on more than one machine at a time. In order to install the program on a second machine (or reinstall

it on the first), you must first execute an uninstall program found on the program's installation disk. Failure to do so renders the product useless.

The publisher might build goodwill by abandoning the copy protection. Still, we can recommend Torah Scholar to Jewish users who seek to move beyond printed Scriptures to the advantages offered by the products in this roundup. □

Torah Scholar Plus Rashi, Version 1.0n, \$219. Requires: 640K RAM, DOS 3.0 or later, 4MB hard disk space. Torah Educational Software Inc., 230 East Rte. 59, Nanuet, NY 10954; 800-925-6853, 914-624-4515; fax, 914-425-1042.

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DON'T GIVE MONEY TO STRANGERS.

Before you give to a heart organization, make sure it's one you trust: The American Heart Association. Since 1924 we've sponsored lifesaving education programs and funded \$900 million in research. Others may copy us, but they can't hold a candle to our heart and torch. To learn more, contact the American Heart Association, 7320 Greenville Ave., Box 20, Dallas, TX 75231.

You can help prevent heart disease. We can tell you how.



This space provided as a public service.

Abort, Retry, Fail?

THE LIGHTER SIDE OF PERSONAL COMPUTING

By Don Willmott

Terrifying Typo

"Ramtron just went public in February. It is already selling FRAM chips with 4 kilofits of memory."

—THE DENVER POST

Classified Intelligence

"KAYPRO Computer, have books & discs, don't know how to use. \$300/trade for lrg iguana."

—THE SACRAMENTO BEE

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Brain-Twister Department

Here are some instructions from the IBM PS/2 N51SX manual:

"Is this manual written in English?"

Yes Go to Step 9 on page 9.

No Copy the Reference Diskette onto the hard disk."

Mars Goes Multimedia

Time Warner Interactive Group and The Planetary Society have created a literature-and sound-filled CD-ROM called Visions of Mars.

It will be placed on the Mars 94 spaceship, which is expected to arrive on the red planet in September 1995. To make sure the Martians have no trouble accessing the elaborate multimedia files, the disk is both Macintosh- and IBM-compatible.

How many calories in sheet metal? (Dell Computer Corp. Advertisement.)

Operator, I've got a bad connection. (Macy's Advertisement.)

Digital answering machine
Digital technology eliminates the need for tapes
Time/date stamp Remote access
Voice menu Digital display Model 1343
17206. (D.216)

new! \$229
Tropez 900MHz Digital Cordless Phone

Digital voice encryption system for increased clarity Up to 5 times conventional cordless range Digital audio transmission for less interference Auto 20-channel search/select Fully digital base-to-handset link Tone/pulse switchable Model 900 DL #917204. (D.216)



Onward to Secession

"Flags Prompt Change your DOS prompt to your choice of the flag of 67 different countries including Texas."—THE PUBLIC BRAND SOFTWARE CATALOG



Audubon's Mammals

Retail Value: \$49.99
Photos, animation, facts and details on the most amazing beast on earth—the mammal. From the studies of James Audubon, this

Ducks don't breast-feed. (TigerSoftware Catalog.)

Richard Tennant

If your entry is used, we'll send you \$50 and a PC Magazine T-shirt. Send your entries to Abort, Retry, Fail?, PC Magazine, One Park Ave., New York, NY 10016-5802. Winners this issue: Paul Chapin, Judy Harris, Oscar Martin, Terry Meachem, N. Claire Miller, Rick Roberts, and Glenn D. Shoup.

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TO YOUR
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AS
YOU ARE.**



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- BLOCK MODE IDE DISK TRANSFER
- FLASH RAM BIOS
- EMBEDDED DIAGNOSTICS
- ONE DISKETTE DRIVE (3.5" OR 5.25")
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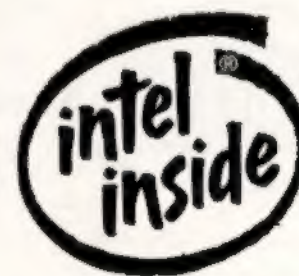
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- 340MB IDE HARD DRIVE
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